TELEPHONE ENGINEER

VOLUME 29 MAY, 1925 Number 5

A WORKING EXAMPLE OF EMPLOYE OWNERSHIP

An official of one of the state telephone associations happened to be in a certain city where the telephone system is operated by a notably successful, locally-owned company. As it was the day for the monthly directors' meeting he was invited to attend the meeting. When the directors were assembled, rather to his surprise he found that he was attending a meeting of the president and general manager, the plant superintendent, the chief operator, the auditor and the attorney for the company. Upon inquiry he found that these are the directors of the company, and he also learned that the list of the common stockholders is identical with the list of supervisory employes and that no individual owned a controlling interest.

This company is a working example of a plan that is being suggested by some advanced sociologists as a practicable solution for many of the industrial problems of the day—participation of the employes in the management and earnings of the modern corporation. This plan of participation is not an experiment in this particular case, as it has been in operation for years, and its success makes certain its continuation. It has passed the stage of being a theory and has become a fact.

The increasing amount of employe ownership of stock is a step in the direction of the working out of such plans in other corporations and the next logical step is employe representation on boards of directors. Slowly but surely industry is passing into another stage and that stage seems to be one in which the bonds and preferred stocks of corporations will be held by the big outside investing public and the voting stock will be owned by those who actually operate the industries. Some may say that it is socialistic, but it is a socialism that places a reward upon individual initiative and enterprise and gives the employe an incentive to work for something beyond quitting time and pay day.

BOOKS ON OUTSIDE PLANT CONSTRUCTION

In the "Line and Desk" department of this number, an inquiry for a book on multiple cable distribution is answered by the statement that no book is available in which this subject is treated in a complete manner. The answer might have gone further and said that there is no satisfactory treatise of a general nature on outside plant construction methods. Comment has appeared in these columns before on the paucity of literature on the telephone. To a certain extent this is being remedied, as may be observed by reference to our occasional book reviews, but the outside plant has received only casual attention in the books that have been published.

It is true that the Bell companies have elaborate specification books covering every detail of outside plant construction, and many other companies have specification books of the same general nature, but these are concerned merely with the manner of doing the work and not at all with the reasons for doing it in a certain way. There is need of a book dealing exhaustively with the principles of outside plant design and including a discussion of the specifications, giving the main reasons for the adoption of the various practices.

Belonging to the outdoor type of man, it is probable that the plant engineers do not turn easily to the labor of the pen, but there certainly should be one among them who can provide the telephone art with a much needed treatise on this special line of endeavor.

THE NEW EDIFICE OF INDEPENDENT TELEPHONY

Executives of Class A, Independent telephone companies, met for the second time in conference at Chicago, in April, at the invitation of the United States Independent Telephone Association. Representatives of these companies came together from all parts of the country—from New York to California and from Minnesota to Florida—to discuss and consider policies of common interest to the group. While the meetings were executive in character, sufficient information has been given out concerning the sessions and the conditions among Class A companies to indicate the stability of the founda-

tion on which the Independent side of the industry is built.

Financial soundness is shown by comparative statistics for the 32 companies that make up the group. At the close of 1924, these companies were operating a total of 651,674 stations, showing a gain of 6.25% for the year and of 66% since 1916. Total assets were over $116,000,000, represented by $88,000,000 in capital stock and funded indebtedness. Net earnings of the group for 1924 were 6.5% of the fixed capital and were equal to 9.1% of the capital stock. In 1916, these ratios were 5% and 6% respectively for the same group of 32 companies. Depreciation is being set up at an average rate of 4.3% as against 2.1% in 1916, thereby making much more adequate provision against the wearing out of the plant.

Another foundation stone is the character of the men on whom the destinies of these companies depend. The attitude of the men who gathered at Chicago was that of men who have faith in the industry with which they are associated and who are willing to work out its problems so that the industry may progress. Conservative yet progressive, they are willing to adopt new methods in construction, operation and financing, yet always retaining such of the old methods and practices as have been proved by the experience of the past. That they are interested not only in their own problems as individual companies and as a group, but in the welfare of the industry as a whole is shown by their consideration of the problems of the smaller companies along with their own.

On this foundation—for the Class A companies ARE the foundation—is being erected the growing structure of Independent telephony. The materials are being gathered in the collective experience of the companies, and the builders are at work. Soon other groups of workers will be added when the regional conferences of smaller companies are held. Under the able direction of association officials and special committees, the materials will be put into place and an edifice will arise that will withstand the test of time and weather the storms of passing years.

GOOD WORK CAN NOT BE DONE WITH POOR TOOLS

As a workman is known by his tools, so, also, it may be said that a telephone company is known by its tools. A fine cabinet can not be built with a rusty saw and a dull chisel, and a good job of line work can not be done with inadequate tools. Much expensive material has gone into the building of very poor lines because construction gangs have not been equipped to do the work well.

IS RADIO BROADCASTING LEGITIMATE TELEPHONE OPERATING EXPENSE?

According to newspaper reports, the District of Columbia Public Utilities Commission has ruled that an investment in radio broadcasting station equipment is not a proper portion of the valuation for rate-making purposes of the Chesapeake and Potomac Telephone Co., and has held that the expense of radio operation is not properly chargeable to the telephone operations of the company, if a deficit is incurred. Apparently, the position of the Commission is that the radio station must stand on its own feet and its profits and losses must be treated as a separate department, rather than as a portion of the telephone business.

Not many telephone companies will be affected by this decision, even if it should be followed by similar decisions by other commissions, as few telephone companies under commission regulation have entered the broadcasting field. It may affect other utilities, however—particularly in the electric light and power field—as a number of such companies have installed and are operating radio stations.

The broad question opens up as regards the extent to which utilities may engage in other activities, outside of the primary business in which they are engaged, and as to which of these activities may be considered a portion of the ordinary operations and which must be segregated. Future decisions along this line will be watched with interest.

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General Business and Editorial Offices, 28 E. Jackson Blvd., Chicago, U. S. A. Telephone: Harrison 4000.
W. H. Graffis.....Gen. Mgr.
R. V. Achatz.....Technical Editor
Herbert Graffis.....Bus. Mgr.
Jos. M. Graffis.....Advertising Mgr.
Eastern Office, 56 W. 45th St., New York. Tel. Vanderbilt 3695.

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ADVERTISING

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NOW IS ACCIDENT PREVENTION TIME

If there is any time of year when special stress needs be laid on the prevention of accidents, it is during the spring and early summer, when new men are being added to the construction forces to carry out the programme of plant extension. Not only is this true among the large companies, but among the smaller ones as well. There is no company so small that it can not bring to the attention of its workmen the necessity of always doing their work in a safe manner. This is not a matter of an elaborate set of rules, but is the cultivation of a habit of thinking safely while at work.

The Mitigation of Static

Static Disturbances Are Practically Constant on Grounded Lines and Occur Under Certain Conditions in Metallic Circuits. Possibility of Finding a Method of Mitigation Is Discussed

By JOHN M. WALSHE

The study of electricity in the earliest times, practically was confined to experiments with frictional apparatus. After the discovery of the Voltaic cell it was found convenient to call the two branches of electricity by separate names and the term "static electricity" was used to describe the electricity produced by frictional methods, because it was often found on non-conductors such as glass, silk and fur, in what was apparently a state of rest. "Dynamical electricity" described the electricity produced by the Voltaic cell and was so called because it consists of electricity in motion. Although telephony is only possible by using dynamical electricity it is found that the effects of static electricity often cause serious interference on telephone lines.

The presence of static electricity or more shortly called "static" on telephone wires may be due to one of several causes.

The more common causes are atmospheric. Among them are thunder clouds, wind storms, dust storms, snow storms and sleet storms. The effects of these are all more severe when accompanied by strong wind. Another cause is the proximity of transmission lines carrying high tension currents.

The Cause of Static Noises

In considering the effect of static on telephone lines such line will be presumed to be a metallic circuit equipped with some form of air gap arresters at each end and strung on the usual pole lines.

These wires for long distance use are kept well insulated from each other and from ground. When a storm begins, an electric charge appears to be deposited in each wire equally. The presence of this charge is not in itself harmful nor is the user of the line aware of such a charge until its potential becomes so great that the charge breaks down the air gap at one of the arresters and a spark passes to ground.

It appears almost certain that one of the four air gaps will present less resistance to a disruptive discharge than any of the others. It may be very slightly less but as long as it is less, the discharge will occur there. The charge on one wire may discharge without causing interference in this way but the other wire can now discharge through the receivers at the ends and as it does so, loud noises are produced thereby.

Such discharges may take place at short or long intervals of time in accordance with the severity of the disturbance. They frequently render lines useless for hours at a time. There are other types of noises met with on long distance lines which are not commonly spoken of as static but which are in reality of the same origin. One of these cases may happen on a line when others on the same route are perfectly quiet. It will be found that its insulation has been lowered in some way and the trouble can often be located and cleared in the usual way. The noise is caused in the same way as in the case of the disruptive discharge, the small charge finds a path to ground through the point of low insulation, the resistance of the path varies and the flow from the well insulated wire through the receiver varies accordingly, causing a frying or rasping noise. During thunder storms static is not usually continuous but varies as the charged clouds pass over. It is often found that the interference lasts only as long as the storm. It may therefore be taken as a general rule that the amount of interference from thunderstorms depends on the liability of the particular locality to thunderstorms.

Static caused by thunderstorms is frequently more severe than that caused by wind and the lines may be so highly charged that considerable personal risk is taken by trying to use them. This condition can be easily recognized by noticing the arcing at the arresters.

How Static May Be Neutralized

It will be of interest to examine how the effects of static can be neutralized Before proceeding to this, however, it will be in order to state what properties should be possessed by a device to neutralize static.

The problem seems to be this: A static charge is collecting continuously on each wire. To mitigate its effects: (1) this charge must be removed as fast as it accumulates, (2) its removal must not ground the line, (3) it must not interfere with the use of the lines in any way, (4) the useful energy being transmitted, must not be absorbed. (5) The device should only operate when the voltage rises above the normal value. (6) It should not require an unreasonable amount of attention. (7) It should operate silently. (8) It should be of such a nature that it can be left on the line at all times and not require additional switching apparatus or attachments to the line. (9) It must handle large high voltage charges without injury, but is not to be expected to take care of a direct lightning charge. (10) It should be of reasonable size and cost.

Some of the available means to meet these requirements will now be considered:

Air gap arresters composed of saw tooth edges of metal or carbon and of carbon or copper blocks with separators of mica are not found to fulfill the requirements as they do not provide a continuous path for the charge.

"Drainage coils," or as they are sometimes called, "static coils," consist of a winding of insulated copper wire of about a thousand ohms resistance, wound on a soft iron core and enclosed in an iron cylinder to complete the magnetic circuit. Such coils are bridged across the lines and the centre point of the winding which is brought out for the purpose, is connected to ground.

It will at once be seen that each of these coils absorbs about as much energy as a thousand ohm ringer. Also that they put a balanced ground on the line which has to be taken into account when the lines are used for telegraphy and telephony. They may not be required at all seasons and extra apparatus is necessary to take care of this condition.

A disadvantage of these coils is that there is no indication when a number of turns on such a coil become short circuited as the winding is enclosed. If this happens the line may become unbalanced and if connected to a long toll line the transmission will be seriously affected. These coils provide a conducting path for lightning to ground, but owing to their high impedance they cannot be expected to provide any protection from it.

Their use as draining coils for telephone lines strung on the same poles as high voltage transmission lines has been found quite satisfactory.

Vacuum Discharge Device

Within the last few years a new device to mitigate the effects of static has been developed. An explanation of the condi-

tions upon which it depends for operation can be made as follows:

The properties of air as an insulator at ordinary pressures and temperatures are known to everyone. Its properties when compressed or rarefied are not so well known. It has been found that when a vessel is partly exhausted of air its resistance to the passage of electricity is reduced and a lower voltage is required to break down a given space between electrodes. If the vessel is still further exhausted a point is reached when the resistance increases again and eventually becomes almost infinite if the process is carried far enough. This latter condition, however, is not desirable for the purpose of static mitigation. An intermediate stage can be produced which renders the use of partially evacuated tubes possible for this purpose.

Vacuum tubes as used on telephone lines have been supplied with carbon electrodes, the space of separation being about an eighth of an inch. Each wire is connected to an electrode opposite to a grounded electrode.

The efficiency of this device will depend on its initial vacuum being of the correct amount and on its maintenance at that value. Failure of the vacuum will not be observed and cannot be verified with ordinary testing apparatus supplied to telephone offices. Protection from lightning may be found desirable in addition. From theoretical considerations it seems likely that this device would fulfill the ten conditions stipulated.

As the voltage of the static charge increased a brush discharge should be observed in the tube which being of a continuous nature should not cause such interference as an air gap. If the line were also supplied with air gap arresters the operation of one of these would render the vacuum tube useless, so the vacuum tube must operate at lower potential than the most sensitive air gap available.

Effects of Lightning

The effects of lightning are of course much more serious than those of static but their nature is the same. To present the conception of these phenomena in another way it will be found necessary to review some of the properties of atmospheric electricity not associated with telephony directly.

In his study of electricity Benjamin Franklin proved that the electricity which he was able to draw from the clouds was of the same character as the electricity produced by artificial means on earth. Later Lord Kelvin measured the potential at different heights above the earth and found that it was forty volts per foot of altitude. Not long ago advantage was taken of these discoveries to secure energy from the atmosphere. This was done by means of captive balloons anchored at a height of a thousand feet or so and connected with the earth by suitable conductors. The balloons were supplied with metal points of radio active alloy sharpened electrolytically.

It was reported that such a balloon collected a few amperes at several hundred volts potential. The incidence of thunderstorms was not mentioned as a necessary condition as was the case with the study made by Benjamin Franklin. Nor does such a condition seem likely to be necessary to those who have had experience with static on long telephone lines in dry weather.

The direction of the flow of current was not specified in the case of the captive balloons. In the experiments of Lord Kelvin, however, the flow of current was found to be from the clouds to the earth. This leads up to the new aspect of the case. The electron theory states that the flow of electrons is in the contrary direction to the flow of current. What is the electrical condition of the atmosphere close to the earth and for the first few miles above it, in view of these considerations? Obviously there is a continual electron emission from the earth at least during daylight and probably during the night also in reduced volume. What becomes of these electrons is at present only conjecture. It is said that radio communication is interrupted during daylight because the higher air becomes ionized by sunlight. Perhaps they assist in this process. Perhaps there is electron emission from the earth due to its being a hot body. The crust which gets hotter in daylight seems to emit more electrons during that period; the interior of the earth is certainly hot enough to emit electrons. This emission may be the primary cause of radio static in which clouds would obviously be an important factor in acting as temporary screens.

Telephone Wires as Electron Radiators

Returning to our telephone line let us see what conditions we may expect in view of these considerations. The wires will form a splendid conducting radiator of electrons and there will be a continuous effort on the part of the electrons to reach these wires, when one conductor is connected to ground at any time, through a telephone receiver there will be sufficient flow of electrons to cause a noise; therefore it is necessary to insulate the line with some of the best insulating substances known. When wind carries dust or snow we should expect it to have its effect and in practice these conditions are realized. Earth currents can be explained by the rate of emission differing in places for some reason as cloud screening, or dry and wet areas, and the effort to equalize such deficiencies by use of conducting wires. In other words unequal electron emission would create unequal potentials over affected areas which tend to equalize by means of wires where these are grounded.

The problem of neutralizing the static which interferes with telephone service is no longer an effort to drain the conductors of their charge. It now becomes a problem of the possible means of continually supplying the conductors with electrons in a noiseless manner and in sufficient quantity to prevent the supply from the earth being necessary.

It would seem at first glance that all that would be necessary to meet these conditions would be to connect the positive side of a source of electrical energy. This would not be effective as the negative side must be left insulated because it is undesirable to ground it. Other suggestions are the use of radio active materials or of a method of utilizing the electron emission of hot bodies.

Another suggestion is to embody radio active elements in the conductor as an alloy. Whether these possibilities can ever be realized is a question that cannot be answered at this time.

It is recognized that damage by lightning and the effects of static are reduced in cities. This is because the large number of conductors provided by buildings, trolley poles, water pipes, etc., are sufficient to carry all the emission without interfering with telephone service. That is, the numerous conductors provide a screen for the telephone lines.

High tension transmission lines have been screened from lightning by erecting a single wire above them. Probably any method of reducing the exposure of telephone wires would reduce the effects of static. The installation of additional lightning conductors on the poles of telephone lines would not, in the opinion of the writer, prove of much value.

The problem of protection from lightning also becomes a problem of conducting the emission of electrons above the object to be protected. In this case the question of supplying the necessary electrons would present too great a problem.

Independent 1924 Convention Now in Record Form

Chicago, Ill.—United States Independent Telephone Association is distributing to member companies complete copies of the proceedings of the 1924 meeting of the organization.

Running a "Friend Factory"

Sound Advice on Making Friends for Utilities by Making Employees Company Friends First — Why Public Lacks Appreciation

By W. J. O'HEA

(Assistant to President, Rochester (N.Y.) Telephone Corporation)

All of you are vitally interested in the people you serve for they are your customers, your payroll, your balance sheet, your dividends, in fact they are all you have that is worth while. And in the final analysis if they are not catered to from a service standpoint the word "trouble" will take on a very sinister meaning in all of your business operations.

The statement is frequently made that the success of any business depends, in a large measure, on the friendliness of the people it serves.

We telephone men and women have a wonderful opportunity to make friends for the industry we represent because of the frequent contracts we establish with the public. For example: The 800 telephone operators of the Rochester Telephone Corporation, establish approximately 300,000 voice to voice contacts with the public daily. By being courteous and accurate they have the opportunity of making thousands of friends and supporters for their company. The same is true to a lesser extent of installers and other representatives of the plant department who, by utilizing every opportunity to do their work in a careful, business-like manner, cannot fail to make a favorable impression on those with whom they come in contact. Likewise the accounting and commercial employes, by rendering bills promptly and accurately and by courteous and tactful handling of inquiries and complaints, can do their part. In fact, the chain is no stronger than its weakest link. We must keep in mind always that we are in the business of serving the public and that it is the service we render, not the service we promise, that secures for us their confidence and good will.

A Word About Complaints.

The handling of complaints has a very important bearing on our public relations. We must never forget that no matter how trivial the complaints or inquiries may be, they must be handled with the utmost tact and courtesy. Under no circumstances should we "pass the buck" by passing a complaint around from one employe or department to another. This will inevitably cause irritation whether the grievance is real or imaginary.

It is impossible to estimate the value of kind words when dealing with the public for we can never tell how, when, or where they will do us a good turn.

Complainants should not be classed as "kickers." Only recently we discovered some service equipment faults of a somewhat serious nature as the direct result of some service complaints. This brings out the value of providing your subscribers with an avenue of approach to the operating head of your organization in the event that complaints are not taken care of promptly and satisfactorily. We take care of this by inserting the following notice in the front of our telephone directory on a page headed "Information for Telephone Users":

Reporting Trouble.

Report all mechanical trouble, and apparent inattention of the operators to the chief operator; then if the difficulty is not adjusted within a reasonable period of time, call the traffic manager.

If trouble so reported is not remedied within twenty-four hours, notice in writing should be forwarded to the general manager, Rochester, N. Y.

The reason for this is two-fold. First it acts as a check on the routine handling of complaints and by the same token is a notice to our employes that complaints must be handled properly. Second—it shows our subscribers that the operating head is interested in seeing that their complaints receive proper attention. Quite a few service improvements have been worked out through the medium of complaints received at our general manager's office. Some faults were discovered which might otherwise have gone on indefinitely. It should be kept in mind always that the first employe the complainant gets in touch with is regarded as the company and the complainant's future opinion of the kind of company we are will be governed by the kind of treatment he receives on his first contact.

Help Employes.

Personally, I believe, and I am sure you do too, that the telephone industry has the finest bunch of intelligent, industrious and loyal employes of any industry anywhere. They are sound and clean physically, mentally and morally, and are so regarded by the public. I sometimes wonder if we give enough thought to aiding them in every possible way to learn more about the great business of which they are the most important part. It isn't enough for them to know their own job for the lineman of today is the potential plant superintendent of tomorrow.

Do your employes know something about your accounting methods and requirements, who established them and why; your financial problems, past, present and future ? Do they know the items that make up a telephone plant? Do they appreciate the importance of conserving life and limb, of being thrifty, of saving and so on down the line? You may say offhand—of course they do—but I will wager that a great many of them do not and if I am correct in my premise, how can you expect them to keep your customers informed if they don't know these things themselves? This is your job and I might add, one of your responsibilities. Let me give you a concrete illustration of how erroneous impressions are created through lack of knowledge on the part of employees.

Not long ago one of our supervisors in the plant department remarked to our financial vice president that we must be making a lot of money. Mr. Brookman replied in the negative and inquired: "What makes you think so?" The supervisor said: "Well, we are doing so much new building that I thought we were making lots of money." This man did not know that we were earning less than four per cent. On the fair value of our property as established by the Public Service Commission, Mr. Brookman pointed out that the money being spent for the large additions to our plant did not come from the earnings of the company, and then explained in detail where it came from. As a direct result of this employe's remark, Mr. Brookman wrote an article for our Telephone Bulletin, which is published monthly, on "The Financial Side of Our Objective," in which he brought out in detail how our operations are financed, developing his story along elementary lines so that every one could understand it. It opened our eyes to the need for education of this sort for if our own people had the impression that we were making lots of money it was a sure thing that a large proportion of the public also had the same idea.

**Digest of address before Ohio Independent Telephone Association Convention.*

Importance of Public Education.

Are you open and above board in your dealings with the public? Are you telling them the things they should know about your business, your earnings, your values, the need for building up a sufficient reserve to take care of depreciations, sleet storms and the like, the need of satisfactory rates, how you have to finance additions to your plant and why your rates should be sufficient to provide not only for all of these factors but for fair wages for the employes who devote their lives to the interests of the public they serve? I can hear you saying—this is all old stuff. Of course it is, but it needs repetition—for the time will never come when you can sit back and say the job is done.

Your business is an intimate and vital part of the committees you serve.

Does the public fully appreciate your services? I venture the opinion—not always. Does it express its gratitude—again I venture to say—not very often. This naturally suggests the question—why? Because it has ceased to wonder at the things we do and expects them as a matter of course. Occasionally they commend us for some unusual service rendered and when they do we appreciate it. The remedy for this sort of thing is in our hands. We must persevere in our efforts to teach the public some of the intricacies of the plant which serves them so that when things go wrong, instead of complaining they will wonder why we make so few mistakes. This goes hand in hand with the education of our employes, of which there are at least two types. First, the type who attempts to enlighten an inquiring subscriber to the best of his ability, and the other—who takes a shot in the air and hopes to get away with it.

Once the public gets the impression that you are not playing the game fairly you are in for a period of bitter attack and criticism from every quarter and we all know the disturbing effect this has on the organization and that it costs lots of real money to combat it. I cannot stress too strongly the need for utilizing every opportunity to show the people that you are running your business in such a way as to give good telephone service for every one at reasonable cost.

It is very helpful in this direction to establish the practice of budget control for it will go a long way towards making it easy for you and your employes to keep the public properly informed. This reference is pertinent because the public is vitally interested in the way you run your business and once they know you are using modern methods in an effort to safeguard their interests you will have their friendship and support. I want to impress you with the fact that to do these things does not require a large outlay of time or money.

Business Papers Are Aids.

I would suggest that you encourage your employes to read TELEPHONE ENGINEER, Telephony, Ohio Telephone News, and any other telephone publication that may come into your hands. These papers have been publishing educational articles on all phases of the industry for years and they will undoubtedly continue to do so. I know of no better method of getting these facts before your employes than by having them read these publications, and in order to make sure that they do so, it devolves upon you to question them periodically. Show them that you are trying to help them help themselves. You will reap the reward just as surely as they and do not forget that the public will profit the most through your efforts along these lines.

Movie Stars Lend Interest to Telephone Window

Indianapolis, Ind.—One of the most interesting window trims recently seen in Indianapolis was that made by the Indiana Bell Telephone in which photographs of prominent motion picture stars were prominently displayed. A testimonial letter from a motion picture company complimenting the Bell's service was the foundation of the display.

Movie-Telephone window trim draws public interest.

The telephone was tied up with the exhibit by the small cards at the top of the background which read as follows:

BELL SYSTEM
Connecting
Studio and Home Office
(Hollywood) (New York)

BELL SYSTEM
Connecting
Home Office and Exchange
(New York) (Indianapolis)

BELL SYSTEM
Connecting
Exchange and Theatre

BELL SYSTEM
Connecting
Theatre and Public

S-C Board Service Wins Praise From Pitcher

Dixon, Ill.—Louis Pitcher of the Dixon Home Telephone Co. recently surveyed the service of a Stromberg-Carlson switchboard the Dixon company has had in service for eight years, and sent an interesting letter relative to the work the board had done, to the manufacturers.

Extracts from the Pitcher reports follow:

"A few operating statistics are: On July 3, five operators handled 2144 calls in one hour. One operator answered 658 calls in an hour on November 15 and in 13 consecutive hours on Position 9 on Dec. 20th there were 5634 calls answered, an average of 433 per hour, and we have a well-grounded suspicion that the peg meter is not tallying all the calls on account of overlap answering. Bergman and Levis are looking into this now.

"Nine years have passed since our big fire and on Feb. 10th we will have beeen operating the S-C switchboard in our present quarters for 8 years with no complaint yet as to its proper functioning.

"Our 1924 trouble statistics show the following:

"Lamps 171; keys 39; relays 140; multiple 9.

"Answering 103 mostly rural drops sticking. Intermediate 3, cords 1,063, plugs 225; note we still have gymnastic tendencies and miscellaneous 86. Not bad for 1300 line with 3550 subscribers."

London, Eng.—An interesting and instructive presentation of the Relay Automatic telephone system is made in a handsome booklet recently issued by the Relay Automatic Telephone Co., Ltd. A copy will be sent on request by the company's headquarters, Marconi House, Strand, London, W. C. 2.

Iuka, Ill.—The Daniels Telephone Co. is rebuilding its pole leads this season.

Laying Underground Conduit

Some Helpful Data on the Planning and Construction of Underground Telephone Systems — Characteristics of Various Kinds of Conduit—Concrete Conduit Work

By P. KERR HIGGINS

In planning any underground telephone system, it is assumed that a complete ultimate underground study has been made and the most economical conduit runs with the required number of ducts have been determined before any work is begun. Many engineers prefer using the alleys wherever possible to do so, but this will be determined definitely by the conduit study. The streets or alleys on which the lines are to be run should then be carefully studied with respect to obstructions and the best location of manholes. Usually a good general idea of the obstructions which may be encountered can be obtained from city and other records and from an inspection of the street or alley surface. Where necessary, test holes should be dug for the purpose of verifying the location of obstructions and for locating others not found in the records. The possibility of the location of street car tracks or sewage or other pipes being located in the future should be carefully studied and as far as possible such locations should be avoided.

In our discussion of underground construction will be included, not only the conduit and manholes, but also the cables, underground cable boxes and fittings, potheads and other means of terminating the underground cable, and other material used, together with the branches through laterals to pole or building terminals and their branches to the interior of city blocks, such as block cables and house terminals. The present tendency is to do as much cable work as existing revenue will permit. In many towns and cities the demand for this class of construction has found the local manager unfamiliar and unprepared to meet the situation.

There is no longer any question as to the advisability and even necessity of placing all telephone lines underground in so far as it is practical, possible and economical to do so, especially in the business or congested section of the city. Underground work as a general proposition is more economical in the long run than overhead cable if the first cost is permissible. As a matter of fact the expense of underground construction is not as great (ultimate saving in maintenance considered) as many of us have been inclined to believe. The saving in sleet storm and tornado damage alone during the past year has more than ever made it necessary to give this matter careful consideration.

Trench Work.

Permits. It is well after the study has been made and before any definite work has been begun that all necessary permits from the city, etc., be secured. This will prevent any interference with the progress of the work or the delivering of material on the job.

Test Holes. Before the work is begun test holes should be dug. It is suggested that one be dug at the end of each block on the proposed line of conduit where manholes are to be located. They should also be dug at other intervals as may be necessary to locate the obstructions. Test holes should be as narrow as possible and only of such depth and length as may be necessary to accomplish the above objective. At street intersections they should be so dug that their length will extend diagonally across the location of the manhole, at an angle of 45 degrees with the line of conduit. This permits the location of obstructions on both streets. The use of these test holes and the data obtained in digging them enables us to decide the location of the conduit and to avoid many surface and underground obstructions. As far as possible, conduits should not be located in the middle of a street to avoid interference from street railways, nor too close to the curb line on account of the greater exposure to surface drainage. When necessary to cross from one side of the street to the other, the crossing should be made as nearly as possible at right angles.

Excavation. Trenches should be of sufficient width properly to accommodate the necessary conduit, leaving a space of at least three inches between the sides of the ducts and trench. The depth should be such that the top of the protecting plank, conduit, or concrete should be not less than eighteen inches from the surface, and in the case of wrought iron pipe or other unprotected type of conduit not less than twenty-four inches from the surface. All excavations made below the bottom lines of conduit should be refilled with good earth and well rammed so as to give a good and even foundation. Wherever it is practicable conduits should be located below the level of gas service pipes crossing the trench.

All material, including pavement and gravel, etc., removed from the trench should be carefully separated so that it can be used again in resurfacing when the work has been completed. This is especially true when excavation is made in parkways, lawns or private right of way. In this case the sod should be cut carefully, taken out and preserved for replacement. If possible, the dirt should be placed on canvas or some other suitable material, so as not to damage the rest of the lawn or parking. Before laying the ducts, if possible to do so it is best to open the trench the entire distance between adjacent manholes so that all obstructions may be in plain view, thus enabling the final line and grade of the conduit to be made.

The location of the conduit should be established by driving one stake in the excavation for each manhole and other stakes along the line of the conduit about ten feet apart. The sides of the trench should be carefully trimmed to permit the proper placing of the conduits. The bottom of the trench should be leveled at right angles to the line of conduit and be free from traps or other holes in which water can accumulate or remain. The trench should have a descending grade toward one or both of the manholes so that perfect drainage may be maintained from the ducts into the manholes. This grade should not be less than three inches in each one hundred feet. Where there are continuous conduit runs in one direction, the incoming and outgoing ducts in anyone manhole should be in line with each other wherever possible. This enables the rods to be pushed from one section to another without interference or damage. When necessary the excavation should be braced or shored to prevent caving.

If blasting is necessary only moderate charges of explosives should be used and the work should be protected

properly to avoid damage to adjoining property or life.

A trench should follow a straight line between manholes, avoiding all curves. When this is not possible curves should have a radius not less than sixty feet and the distance between manholes should not be shortened accordingly. In order to avoid accidents all openings should be protected by some effective means and should be indicated from dusk to daylight by red lamps or some other effective means. In some cases it may be necessary to provide a watchman to prevent possible accidents. Care should be taken to avoid interference with fire hydrants and no material should be placed closer than fifteen feet.

Exposed pipes of all kind should be properly supported and protected from injury. Great care should be taken to keep the trench free from water by draining, pumping or bailing. In refilling the trench, the best part of the material taken out should be used close to the duct, except that necessary for the top dressing. The dirt should be well rammed with two rammers for each shoveller. All large stones replaced in the trench should have the flatside vertical so as to minimize the liability of settling. The refilling of the trench should be allowed to settle thoroughly before putting on the top dressing or pavement and this latter should be done in accordance with the city requirements. All surplus material remaining after the trench has been completed should be removed.

Conduit Materials. Conduit is made of various substances and the types are many. They may be classified as follows:

Virtrified Clay Conduits.
Wrought Iron Pipe.
Fibre Ducts.
Cement Ducts.
Creosoted Wood Ducts.

In the case of wooden conduit, the ducts may be round or square. The round duct is manufactured from solid logs by means of special machinery. The tool for cutting the inner circle is made up of a pipe with a cutting knife fastened in the forward end and a square or rectangular band riveted spirally around the outer surface of the pipe to remove the shavings. The square ducts are made from square timbers cut to the proper dimensions and the inside circle removed in the same manner as for round ducts. The only advantage of the square duct is in piling them up when several ducts are grouped together in the same run. However, the cost is slightly higher. This type of duct is used very little at the present time, the preference being for vitrified clay and fibre ducts.

Creosoted Plank.

Is used in underground construction principally as a protective covering for cable laid in the ground or where sewer tile or creosoted wood conduct is used. Yellow pine lumber is most commonly used. The boards should be of uniform section with the ends sawed square. It should be of the actual size required and not over an inch and a half in thickness and sufficiently wide to protect the duct or cable. The plank should be not less than ten feet in length and longer if possible. It should be impregnated with dead oil or coal tar or coal tar creosote. As a general rule for protecting one tile, the plank should be six inches wide and for two tile it should be ten inches wide.

Wrought Iron Pipe. At bridge crossings for unprotected cable or laterals and other places in conduit construction where the use of the regular conduit is not practicable wrought iron pipe is used. The pipe is furnished in various lengths and may be straight or in bends as required. Each length is provided with threads at both ends and a coupling at one end. Standard wrought iron pipe, three or four inches in diameter, is furnished with eight threads per inch, and lap welded casing of the same size is furnished with fourteen threads per inch. The pipe should be free from crystalline structure, cinders, flaws and cracks and uniform in quality. The interior of the pipe should be smooth and free from scale, rough spots and projections. To preserve it from deterioration, it should be covered with a covering of coal tar, pitch or asphaltum.

Sewer Tile. Sewer tile is made from clay in the same general manner as vitrified clay conduit by pressing the soft clay through a die of the proper form. For conduit the 3 inch size is used, principally for lateral lines. The standard length is twenty-four inches. A sewer tile, connected with the sewer system with a bore of six inches is used for manhole drains. When sewer tile is used for telephone construction, it should be reasonably straight, well glazed both inside and out, and with a smooth, regular bore, free from blisters or other defect that might injure the cable while being drawn in. With it bends are easily made, the lengths being so short as to form a practically smooth interior surface. By selecting pieces with a slight curve, the bend can be made as gradual as necessary.

Virtrified Clay Duct. This is made from finely ground clay, free from stones and pebbles. The lengths are moulded by machinery, dried, placed in a closed kiln and gradually subjected to an intense heat. When the proper temperature is reached, coarse salt is thrown upon the fire in small quantities; a portion of the salt vaporizes and this vapor combining with the silica in the clay, produces a soda-salt or glass which being a glaze forms a part of the body of the conduit. This produces a hard, non-porous product of great strength, which resists the action of gases and acids and is practically everlasting. It usually has a smooth, glossy surface, which permits the cable to pass easily through the duct. Before being shipped from the factory, the conduit is subjected to inspection covering numerous requirements, some of which are the following. 1. That the sections are straight and symmetrical with the proper thickness of walls; 2. That the bore is uniform throughout. 3. That each section is sound and free, within certain limits, from cracks, blisters and other defects. 4. That they are well burned and that the glaze is uniform throughout the entire surface inside and out. 5. A permeability test is made on the conduit to determine its fitness for use in underground work. Specifications usually require that a piece of the conduit after being immersed in water for twenty-four hours at a temperature between 60 and 70 degrees shows no greater absorption than five percent of its weight. All conduit should be carefully examined before being laid in the trench. Single duct, Fig. 1-A is made with a circular bore in order that the duct walls may have greater strength. Multiple ducts, Fig. 1-B (more than one) are made with square bores and round corners. Ducts are usually not more than three and a half inches nor less than three and a quarter inches in diameter. Single duct walls should be not less than 7/16 in. thick. The outside walls of multiple duct should be not less than 5/8 in. and the inner walls not less than 7/16 inch thick.

Standard lengths as follows:

Style	No. of Ducts	Length
Single	1	18 inches
Multiple	2	24 inches
Multiple	3	24 inches
Multiple	4	36 inches
Multiple	6	36 inches
Multiple	9	36 inches

Short sections of all ducts are furnished in 6, 9 and 12-inch lengths.

Laying Multiple Duct.

Multiple duct should be laid in a foundation of well rammed concrete, six inches in thickness for two horizontal layers of ducts or less and four inches for more than two layers. The width of the concrete foundation

should extend three inches beyond the outer walls of the conduit. If for any reason the trench must be located in unstable ground and the ordinary concrete foundation does not provide enough strength, the concrete must be reinforced by twisted steel wire laid longitudinally in the concrete. Two wire galvanized steel strand is used for this purpose. No. 8 BWG, twisted with not less than three and a half

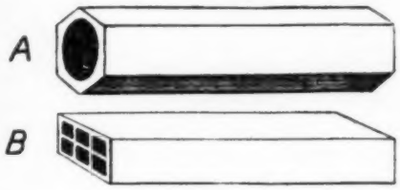

Fig. 1—Conduit construction.

or more than four twists to the lineal foot of strand is commonly used. The breaking weight of the completed strand should be not less than seven thousand pounds. The concrete should be allowed to set before the duct material is placed on it unless absolutely necessary to lay the duct at once, which of course is bad practice. Frequently a layer of mortar is convenient and even necessary between the concrete foundation and the lower layer of ducts to insure an even surface. It may also be necessary between each succeeding horizontal layer. The vertical space between the sides of adjacent sections of multiple duct should be as small as possible and filled with mortar. Multiple duct sections should be laid so as to break joints both horizontally and vertically and be true to line with no shoulders.

Making Joints.

In making joints in multiple duct conduit runs, all pieces should be carefully butted and centered, and the several sections of multiple conduit coupled together with dowel pins. A mandrel should be drawn through each duct as they are being laid. At the end of the mandrel is fastened a heavy rubber or leather washer which is necessary to remove all loose mortar that may be in the ducts. These washers should fit the interior of the duct snugly, and should be changed as frequently as necessary. All joints should be properly protected by a strip of muslin, burlap or other suitable material and should extend smoothly over the end of each section at least four inches on each side of the joints and lap at the top for at least six inches. The covering should first be thoroughly soaked in portland cement grouting and be placed in position before the cement has had time to set. When the joint has been completed it should be well covered on all sides and top with a layer of portland cement at least one-quarter of an inch thick.

When the necessary number of ducts have been laid and properly jointed, the sides of the trench should be thoroughly filled with tamped earth level with the top of the upper tier of ducts. There is now placed over the top of the ducts and extending on each side at least three inches beyond the outside line of the ducts a layer of concrete three inches in thickness. Many engineers place one or more creosoted planks seven-eighths in. thick and enough to equal the distance between the outer-walls of the top course of the conduit. However, this procedure in the opinion of the writer is not considered absolutely necessary.

Laying Single Conduit.

The same general rules used in laying multiple ducts will apply to single ducts. The width of the concrete foundation should be such that it will extend three inches beyond the outer walls of the conduit and the completed duct structure throughout its length shall be well surrounded on all sides with three inches of concrete well tamped into place. In the case of single duct, it may be necessary to use a creosoted plank.

Laterals when laid in the main or the branch trench may be either single or multiple duct as desired. Standard three inch wrought iron pipe is used to connect them with the branch going up to the distributing pole or it may be used the entire length of the branch if not too long. The same general rules will apply to laterals which are laid in the main trench. The top of the riser pipe extending to distributing poles or buildings should be not less then eight feet above the surface of the ground and fastened to the

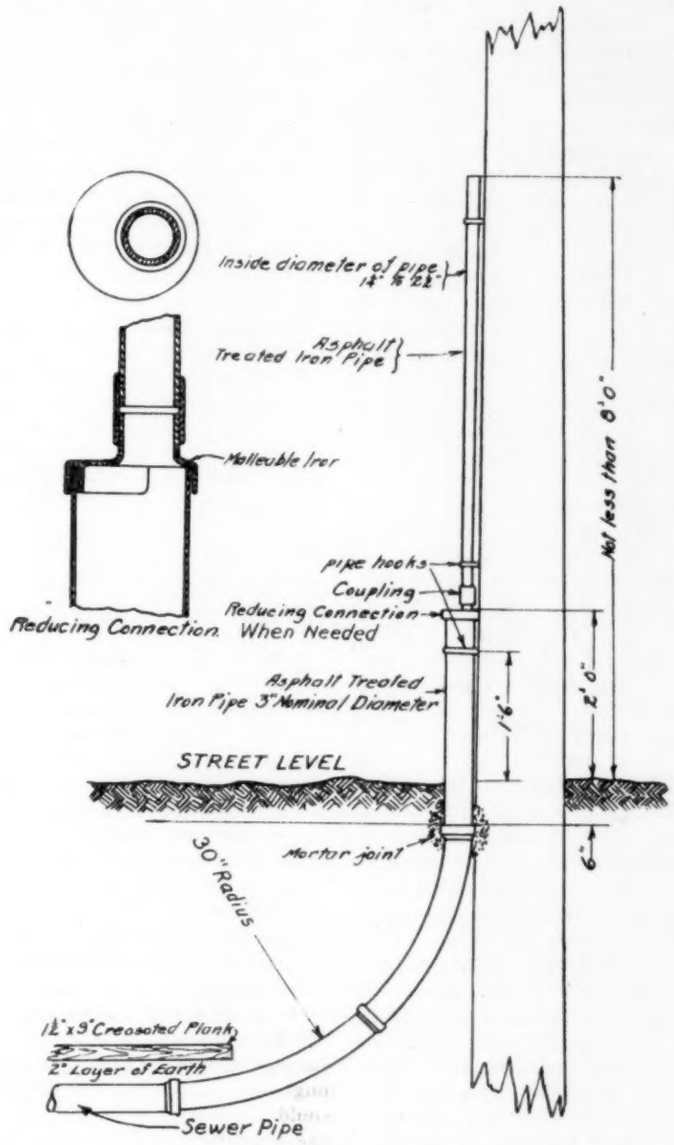

Fig. 2—Lateral construction.

pole or building by "drive pipe clamps" or other suitable fastening. Lateral duct bends when of wrought iron pipe connecting the vertical and horizontal ducts should have a radius of not less than thirty inches. The general arrangement is shown in Fig. 2. Connections between pipe and other ducts should be made with suitable conduit connections. Laterals ending in buildings should have both ends carefully sealed with okum and cement to exclude gas or water. Laterals should slope toward the manhole with a grade of not less than six inches per hundred feet with no sags or depressions where water might accumulate. When it is not possible to have the lateral slope continuously toward the manhole, draining may be secured by perforating the duct at its lowest point. Laterals should be rodded and fish wires of No. 12 galvanized iron wire installed at the time they are laid.

Fibre Conduit.

Fibre conduit is made from paper saturated with a preservative compound. Two general types are in use, one being formed directly from paper pulp in the following manner: By means of special machinery the pulp is rolled while wet, in very thin layers, on a mandrel until the desired thickness of wall is obtained. The pipe is then removed from the mandrel and thoroughly dried until all moisture has evaporated. The pipe is then dipped in a compound with natural asphalt or other suitable material and after cooling, the ends are provided with the joint desired and the product is ready for shipment. In the manufacture of the other type of fibre conduit, the paper (which is in rolls similar to those used in newspaper work) is passed through a bath of hot bituminous compound. The movement of the paper is such that the paper is thoroughly saturated. While still hot it is formed on mandrels and when cool it is ready for the cutting of the desired joints at the end.

General Hints on Conduit Construction.

Delivery of Material. All material required in the execution of the work should be placed along the line of work so as to cause the least possible obstruction and loss of damage to material and interfere as little as possible with the traffic.

Alignment of Ducts. So far as possible and practical all ducts should be laid in a straight line and where curves are necessary, they should have not less than sixty foot radius. Ducts should enter manholes as high as convenient and should be not less than six inches above the floor of the manhole.

Placing Concrete. Care should be taken at all times in tamping the concrete and refilling the trench not to disturb the ducts or concrete which is partially or wholly set. Any loose earth falling into the trench which might interfere with the proper placing and laying of the concrete and ducts should be removed before proceeding with the work.

Foreign Pipes in Trench. When necessary to include obstructions such as gas or water pipes in the concrete protection of the conduit, such pipes should be surrounded with broken stone or sand without cement, to avoid damage to the surrounding concrete due to their removal or replacement.

Ending Ducts. When necessary to adjust the length of ducts, terminating in manholes or buildings, a sufficient number of short pieces of duct of varying length should be used.

Mandrel. After the trench has been completed and resurfaced, a mandrel of hard wood not less than nine inches long and having a diameter of one-eighth inch less than the inside diameter of the ducts should be drawn through each duct from manhole to manhole. Ducts through which this mandrel cannot be drawn are defective and should be repaired at once. When repairs have been made the mandrel should be redrawn through all ducts that have been disturbed.

Plugging Ducts. When necessary to leave unfinished work at night or other times, the ducts should be firmly stopped with wooden plugs or their equivalent and care taken to see that no obstructions remain in the ducts. When conduit runs are completed all ducts should be closed in a similar manner to exclude water Plugs should be well soaked in water before being used.

Concrete for Conduit Construction.

Concrete is a mechanical mixture of loose solids, cement and water. When first mixed it is soft and plastic, but due to a chemical action in the mixture taking place, it soon begins to solidify ultimately attaining hardness and strength. This hardening process progresses almost if not continuously over a long period, but generally reaches a practical maximum in about two months. An ideal concrete would be one in which the different materials used in its composition would be so graded as to size and so mixed as to eliminate all spaces between the different granules. Such a concrete would have great density, hardness, toughness and strength. Moreover it would be waterproof even under pressure. Such a mixture, however, is almost if not impossible; hence the objective is to approach this as nearly as practical in actual work. Usually concrete mixture is designated in proportions such as 1-2-4, which would mean a mixture of one part cement, two parts sand and four parts coarse aggregate, usually measured by loose volumes. However, the proportions do not always gaurantee the quality of the resulting mixture. The best concrete is usually obtained by proportioning according to tests of the constituent parts for the minimum voids.

It is not found necessary in conduit work to make extensive tests or go to any unreasonable expense. However it is well to be familiar with the requirements for a good concrete. Concrete should be mixed in a clean manner, either by hand or by machine. If done by hand it should be mixed on a sheet iron or closely built wooden platform to prevent the waste of water or material. If foreign material is allowed to get into the concrete, its strength will be reduced causing it to become porous and leaky. When concrete is mixed by hand, the crushed stone or screened gravel is placed in a layer four inches thick. Sand or stone screenings is then added and spread out evenly and the cement added and evenly distributed. The cement, sand and stone is then turned over at least three times dry. Water is then slowly added and the wet materials again turned over at least three times or until mixed and all the surfaces of stone completely covered with mortar. Water should be added by means of a rose nozzle or sprinkling can. Mortar and concrete should be made up only in such quantities as are required for immediate use and should never be used after it has begun to set.

The following proportions are suggested for trench and floors of manholes: One part Portland cement, four parts of sand and eight parts of three-quarter-inch stone or screened gravel. For roofs and walls of manholes, one part of Portland cement, three parts of sand and five parts of three-quarter-inch stone or screened gravel. Great care should be taken to use sufficient water in the concrete so that when tamped after being placed the water will flush to the surface. In other words concrete for this purpose should be sufficiently moist so that when in place the mass will be in a semi-fluid condition. Concrete should be laid in a trench as soon as practicable after mixing and the quantity so regulated that the amount used will not have to remain longer than thirty minutes from the time of adding the water before using. When concrete is placed in the trench it should be allowed to take its initial set before the trench is filled in. Otherwise, the

ducts are liable to be fractured or put out of alignment.

In the use of concrete during very cold weather, great care should be taken that it will not freeze, as this not only retards the setting of the concrete, but often completely destroys it. Heating the material, adding sufficient salt to the water to give a solution with a strength of less than ten per cent, thorough covering of the concrete after it is laid will ordinarily prevent freezing.

For conduit work many engineers use a mixture of 1-3-6 or 1-4-8 and a mixture of 1-2½-5 for manholes. The proper mixture to be used must be determined in every case by the person in charge of the work to be performed, as opinions differ greatly.

Manuals for Concrete Work.

Coarse Aggregate. The aggregates other than sand principally used in concert for underground work are crushed or broken stone and gravel. Crushed limestone makes a very good aggregate, the cement adheres to this much better than most other rocks because of their rough, fractured surface. Gravel of the proper grade is also good and much better than broken stone. Gravel in order to get the best results should be graded in size from fine to coarse particles. The best aggregate comprises a large variety of sizes of particles and so graded that they fit together with the smallest possible space between the particles. The cement should slightly more than fill all the spaces between the solids of the aggregates. As a general rule ordinary gravel has too much sand and is dirty. These faults can be overcome by screening, remixing or washing.

Fine Aggregate. Fine aggregate commonly known as sand is a product of decomposition of rocks and when of good quality has a very large proportion of silica. Sand is usually composed of round or sharp (angular) grains. Sand composed of a mixture of fine and coarse grains will give the greatest strength and less cement will be necessary than when composed of grains of uniform size. As a choice between coarse and fine sand of uniform size the coarse sand is the better. If fine sand must be used, an additional amount of cement must be added if the strength of the mortar is important. Sand should be clean, free from vegetable matter or loam and have a very small quantity of clay if any, and never over five per cent. The character of sand can usually be determined by "its feel" when rubbed between the thumb and finger. Its cleanliness may be determined by placing some in a clear glass filled with water or a bottle when the sand will settle and the fine dirt come to the top and the relative proportions be determined by observation. When necessary to clean sand, it may be done in the following manner. Build a loose board platform between ten and fifteen feet long and so arrange that one end of the platform is a foot higher than the other. On the lower end and on the sides, nail a board two by six inches on edge to hold the sand. The sand is now spread over the platform in a layer three or four inches thick and washed with a hose, starting at the upper end. The water is allowed to run through the sand and over the board at the lower end of the platform.

Mortar. When cement is mixed with sand and water the mixture is known as mortar. The addition of sand to the cement not only cheapens this mixture, but actually improves it by preventing shrinkage. Mortar is used in underground conduit work in binding together bricks used in the construction of manholes and to join together vitrified clay conduit and sewer tile. It is usually mixed on a platform or in a wooden box in the following manner. The sand is first spread out to a thickness of about two inches. The cement is added and evenly distributed. It is then thoroughly mixed together dry. Sufficient water to form the mortar into a stiff paste is then added and the materials worked over until thoroughly mixed, so that every particle of the cement has been dampened. For brick work and lateral joints use one part Portland cement to two parts sand. For conduit joints, one part Portland cement and one part of sand. The amount of water required for mortar varies in the proportion of sand to cement, the character and condition of the material, the weather and the purpose for which it is to be used. If the weather is hot and dry, more water must be added for evaporation. If used in contact with brick or porous stone, the mortar must be more moist than when used with tile or hard rocks.

Portland Cement. Portland cement is produced by burning to semi-fusion an intimate, artificial mixture of certain materials such as lime stone and clay and then reducing this burnt material to powder. It received its name from the resemblance which mortar made of it bears to a stone found in the Isle of Portland off the coast of England. It has usually a bluish gray color, but this is not a positive means of identification. Its quality depends upon the quality of the raw materials used, their proportions in the mixture, the degree to which the mixture is burned, the fineness to which it is ground and the other details of its manufacture. It should be delivered in original packages, bearing the name of the brand and the manufacture. A bag of cement contains ninety-four pounds net and a barrel contains four bags or about four cubic feet of loose cement.

The following are some of the specifications for Portland cement. The specific gravity, (thoroughly dried at 212 degrees F.) must be not less than 3.10. It should have a clear feel in the hand, almost like flour. The standard test requires that it shall leave by weight a residue of not more than eight per cent on the number 100 and not more than twenty-five per cent on the number 200 sieve. When making this test the sieve must be thoroughly dry. This test is very important. It shall develop initial set in not less than thirty minutes and a hard set in not less than one hour nor more than ten hours. It is well to note that sand retards setting. The minimum requirements for tensile strength for briquettes of neat cement one inch square in section is as follows: AGE—Twenty-four hours in moist air—one hundred and fifty to two hundred pounds. AGE—Seven days (one day in moist air, six days in water) 450 to 550 pounds. AGE—Twenty-eight days (one day in moist air, twenty-seven days in water) 550 to 650 pounds.

The crushing strength of Portland cement varies from eight to twelve times the tensile strength. Expansion and contraction tests are as follows: Pats of neat cement about three inches in diameter, ½ inch thick at the center and tapering to a thin edge, shall be kept in moist air for a period of twenty-four hours.

(a) A pat is then kept in air at normal temperature and observed at intervals for at least 28 days.

(b) Another pat is kept in water maintained as near 70 degrees F. as practicable and observed for the same period of time.

(c) A third pat is exposed in any convenient way in an atmosphere of steam above boiling water in a loosely closed vessel for five hours. These pats must remain firm and hard and show no signs of distortion, checking, cracking or disintegrating. Samples should be a fair average of the contents of the bag or barrel under test and one in every ten should be sampled. The sample taken from the bags should be from the ends and center. The same is true of the barrel in which case a hole should be made in the center of one of the staves midway between the heads.

Class A Independents Thrive

Conference at Chicago Shows Major Independents in Excellent Condition—Sessions Devoted to Intimate Discussion of Problems and Practical Solutions

Chicago, Ill. — Substantial evidence of the thriving condition of the Independent structure was brought to light at the second annual conference of Class A member companies of the U. S. Independent Telephone Association, held at the Edgewater Beach Hotel, April 21-23.

All meetings were of an executive character so the forty representatives of the 16 Class A companies attending freely spoke out "in meeting," and tackled their mutual problems without reserve. So thoroughly satisfactory have the Class A meetings been that similar meetings are being arranged for Class B and Class C companies.

In view of the "star chamber" nature of the sessions no details of the discussions of the lively and resultful meeting are to be given general publication. The one illuminating publicity release which testifies to the soundness of the general Independent situation is the comparative general summary of the Class A Independent statistics reproduced here.

The program was divided into a daily general session, followed by a group meeting of executives and accountants. The schedule:

General Session, April 21.

Statement by President F. B. MacKinnon of conference plans and explanation of statistics presented and analysis of annual reports of "A" companies for 1924 and comparison with previous years.

Discussion of the use of charts and graphs in presenting statistical data. W. H. Lemon, general auditor, Lincoln Telephone & Telegraph Co., Lincoln, Neb.

Report on questions that have arisen at the Washington office in connection with income tax and Interstate Commerce Commission cases handled for member companies. Alfred L. Geiger, general attorney for the United States Independent Telephone Association at Washington.

Income Tax Cases:

(a) Reduction of invested capital for past depreciation.

(b) Invested capital for tax purposes as affected by depreciation charged out of surplus, and other accounting errors impairing invested capital.

(c) Cases involving the depreciation rate for federal tax purposes.

(d) Changes in tax administration since last conference with special reference to decentralization of the income tax unit, and the creation of the United States Board of Tax Appeals and its decisions in telephone cases.

(e) Use of appraisals in cases involving invested capital.

(f) The treatment of receipts from salvaged materials.

(g) Special assessment of telephone companies by the use of comparatives.

(h) Invested capital as affected by reorganizations and consolidations.

Interstate Commerce Commission Cases:

(a) Use of appraisals with bureau of accounts to show true invested capital.

(b) Wiping out of reserve for de-

	1916	1922	1923	1924	1916-1924 Increase	1923-1924 Increase
Number of central offices	627	667	668	696	69	28
Number of telephones	392,240	570,283	613,417	651,674	259,434	38,257
Miles of toll circuit	.....	.....	.....	149,272	.....	.....
Fixed capital	$ 64,365,342	$ 92,539,032	$ 93,890,457	$100,496,370	$ 36,131,028	$ 6,605,943
Total assets	73,054,656	105,508,789	107,378,361	116,683,290	43,628,634	9,304,929
Capital stock	32,816,361	44,760,044	44,334,502	49,756,473	16,553,109	3,421,971
Funded debt	24,385,822	32,528,095	33,115,898	38,205,212	13,819,390	5,089,314
Operating revenue	$ 10,748,747	$ 22,834,845	$ 24,440,982	$ 26,036,796	$ 15,288,049	$ 1,595,814
Depreciation	$ 1,383,119	$ 3,710,582	$ 4,042,309	$ 4,350,313	$ 2,967,194	$ 308,004
Current maintenance	1,800,108	3,852,118	4,129,690	4,307,196	2,507,088	177,506
Traffic	1,855,212	4,840,078	4,896,561	5,059,092	3,203,880	162,531
Commercial	948,700	1,885,624	1,966,753	2,042,636	1,093,936	75,883
General and miscellaneous	720,662	1,467,929	1,441,272	1,516,659	795,997	75,387
Total operating expenses	$ 6,707,801	$ 15,756,331	$ 16,476,585	$ 17,275,896	$ 10,568,095	$ 799,311
Net operating revenue	4,040,946	7,078,514	7,964,397	8,760,900	4,719,954	796,503
All other revenue	9	273,008	326,516	495,381	495,372	168,865
Taxes	456,729	$ 1,423,748	$ 1,665,119	$ 1,878,871	$ 1,422,142	$ 213,752
Other reductions	369,140	778,554	838,578	800,138	430,998	(d) 38,440
Total deductions	$ 825,869	$ 2,202,302	$ 2,503,697	$ 2,679,009	$ 1,853,140	$ 175,312
Income available for interest and dividends	$ 3,215,086	$ 5,149,220	$ 5,787,216	$ 6,577,272	$ 3,362,186	$ 699,056
Interest	1,256,372	1,830,881	1,917,250	2,053,686	797,314	136,436
Available for dividends	$ 1,958,714	$ 3,318,339	$ 3,819,966	$ 4,523,586	$ 2,564,872	$ 703,620
Percentages						
Income available for interest and dividends to fixed capital	5.0	5.5	6.2	6.5		
Net income to capital stock	6.0	7.4	8.4	9.1		
Interest to funded debt	5.2	5.6	5.8	5.3		
Depreciation rate	2.1	4.1	4.3	4.3		
Operating ratio	62.4	69.0	67.4	66.3		

Gain in Telephones
1916-24 ..... 66%
1922-23 ..... 7.5%
1923-24 ..... 6.25%

(d) Decrease.

preciation against plant assets in connection with the sale of a telephone plant at reorganization.

(c) Correct accounting treatment of loss on duplicate plant in consolidations.

(d) To what account shall be charged the cost of reconstructing purchased plants?

Dividing line between depreciation and maintenance. Shall definite units be adopted as Association procedure? A. C. Cragg, general auditor, Tri-State Telephone & Telegraph Co., St. Paul, Minn.

Executives' Session, April 21.

The Rebuilding of the Rate Structure, Physical Properties and the Financing of the Home Telephone & Telegraph Co., Fort Wayne, Ind.

(a) Explanations of the plant, service and financial condition of the property August 1, 1919, and statement of the various steps taken to correct those conditions. Frank E. Bohn, vice-president and general manager.

(b) Discussion of the plant rehabilitation. H. E. Gray, general plant superintendent.

Accountants' Session, April 21.

1. Discussion of depreciation and maintenance units as proposed. A. C. Cragg.

2. Discussion of accounting questions submitted at morning session, A. L. Geiger.

General Session, April 22.

The Rebuilding of the Home Telephone & Telegraph Co., Fort Wayne, Ind.

(a) The procedure followed in service rehabilitation, E. L. Gaines, traffic superintendent.

(b) Accounting problems in connection with the plant rehabilitation. Discussion by F. J. Tellman, auditor.

Executives' Session, April 22.

1. The relation of the Class A companies to the Class D companies.

2. Discussion of questions submitted to accountants' conference.

Accountants' Session, April 22.

1. Continued discussion of questions presented at previous session.

2. Destruction of records. Should the Interstate Commerce Commission procedure be revised?

3. Pricing of used materials. What shall be the Association rule?

4. Needed changes in Interstate accounts.

General Session, April 26.

1. Discussion of and vote upon the following questions:

(a) Shall the Association adopt the Minnesota units for depreciation and maintenance to be recommended to all member companies?

(b) Shall the Association ask for a revision of the Interstate Commerce Commission rules on destruction of records?

(c) Needed changes in Interstate Commerce Commission's system of accounts.

2. General discussion and recommendations.

Belle Plaine, Iowa.—Home Telephone Company, new owner of the local system, plans to completely rebuild the plant.

Omaha, Neb.—Omaha leads the world in telephones per capita with one telephone for 3.5 persons.

COMPARE THESE RECORDS, 1860-1925

The "Rochester Telephone Bulletin" recently carried the following notice of speed of communication in 1860:

"On April 12, 1860, all records for the transmission of news from the Atlantic coast to the Pacific were broken when dispatches were printed in San Francisco nine days after being sent from New York. Important government messages and news dispatches which had been wired from the East to St. Joseph, Mo., were carried from that point by the first pony express rider in eight and one-half days to Carson Valley, Nev., where they were again relayed by wire to San Francisco. This reduced the time for the transmission of messages across the continent from twenty-three days to nine days and demonstrated the feasibility of a transcontinental railroad."

Compare this with the following record, made 65 years later, as told in the April number of "Long Lines":

"In this case the calling party's request for 'Long Distance' was received by a recording operator at 8:29 a. m. She noted on a ticket the time, and also the information that the called party might be reached at Fairfax 7006, Pershing Hotel, Chicago. She then sent the ticket by pneumatic tube to a distributing operator who in turn passed it along to the outward position where Miss Christy was 'on her mark,' ready to speed the message. Thirty or forty seconds had now elapsed since Mr. C. filed his call, and the preliminaries were over.

Over the familiar Bell highway stretching away to the west Miss Christy sped the message a distance of over 900 miles, searched out the distant party in room 619 of the hotel, and had the parties talking at 8:32—three minutes after the calling party took down the receiver at his Brooklyn residence!"

Tri-State Largest United States Independent

St. Paul, Minn.—The Tri-State is getting considerable publicity in Minnesota newspapers as the largest U. S. Independent Telephone Company. Some interesting statistics on its operations which the newspapers present, follow:

The company has almost 100,000 stations.

The average number of persons employed during the year 1924 by The Tri-State was 2,132. The total pay roll was $2,280,523, an increase of $54,-012 over the previous year. The physical properties of the Company, exclusive of material and supplies on hand, represent an investment of $17,-439,550.

At the close of the year the Company operated 29 exchange properties, 5,880 miles of single wire of which 69 per cent was underground. A total of 3,845,013 outward toll messages were handled on the system during the year and local exchange messages averaged 583,812 a day.

The program for 1925, as announced by G. W. Robinson, President, involves the expenditure of about $1,-600,000 on the system.

F. A. Montrose Made Indiana Bell General Manager

Indianapolis, Ind. — F. A. Montrose has been made general manager of the Indiana Bell announces C. H. Rottger, president of the company. Mr. Rottger has been general manager as well as president of the company, and the reorganization announced will relieve him of the duties of general manager.

Mr. Montrose was chief engineer and general superintendent of the plant. Mr. Rottger also announced that William H. Curran has been promoted to succeed Montrose as chief engineer and that J. W. Hanon has been promoted to general superintendent of the plant.

Mr. Montrose entered the telephone business with the Chicago Telephone Company after graduating from the University of Michigan in 1906.

State Association Executives to Meet in Chicago

Chicago, Ill.—The first spring conference of state association executives for three years is to be held at the Edgewater Beach Hotel, Chicago, May 26 and 27, according to the call issued by President F. B. MacKinnon of the United States Independent Telephone Association under whose auspices the conference is to be held.

The Transmission Problem

Adequate Transmission With Most Economical Plant Design Is Aim of Modern Engineering Practice — Importance of Size of Wire, Loading, Type and Spacing of Repeaters

By F. J. DOMMERQUE,
Fellow, A. I. E. E.

The transmission problem resolves itself into finding ways and means by which the sizes of conductors and the length limits of lines are determined over which satisfactory telephone transmission can be effected. As unit of transmission the standard cable mile has been used in the English speaking countries ever since transmission studies have been made. This unit is to be superseded by a new unit, for the principal reason, that since the use of carrier currents has become general a distortionless unit independent of frequencies has become desirable, aside from the fact that the standard cable mile is an arbitrary unit, although it has served its purpose well.

The new transmission unit (designated by T. U.) proposed by the Bell engineers is defined as a ratio of powers. It is not the purpose of this paper to go into a discussion of this T. U. as its application to the complete series of circuit elements has not been worked out yet. However, an opportunity offers itself to investigate the transmission problem by making use for the present of the transmission unit as it has been established in continental Europe in place of the standard cable mile. This unit is not arbitrary but based upon the transmission theory; it is the attenuation measure "b" of a line, which is expressed by the product of the attenuation constant into the line length. The relation between the standard cable mile and this theoretical transmission unit is such that a standard cable mile can be transformed into a theoretical transmission unit by multiplying by 0.106. To transform standard cable miles into the new American T. U. the standard cable mile is also multiplied by the factor 0.106; therefore, for the purpose of the subject treated in this paper no error is made by using the designation T. U. for the theoretical unit defined as the product of the attenuation constant and unit line length. The deductions made here by the aid of the theoretical transmission unit will hold good also for the new American T. U.

The acoustic power of speech is transformed in the transmitter into electric power which may range from 0.1 to 15 milliwatts. This electric power is transmitted to the receiver and must at its arrival at the receiving end amount to at least 0.002 milliwatts to produce intelligible speech when reconverted into acoustic power. For sake of calculation the electric power at the sending end may be averaged at 2 milliwatts. The ratio of the sending end or electric input power P_s to the receiving end or electric output power P_r is determined by the relation $\frac{P_s}{P_r} = e^{2b}$. For the values P_s = 2 milliwatts and P_r = 0.002 milliwatts the value of "b" is found as

$$b = \frac{1}{2}\log_e\frac{P_s}{P_r} = \frac{1}{2}\log_e\frac{2}{0.002} = 3.5$$

(in round figures).

This means that the losses in the two subscriber's instruments, in the two subscriber's lines, in the office apparatus as far as it enters into the connection, plus the losses caused by any wavereflection at the points where the line elements are connected together, give an attenuation measure of 3.5. As a subscriber may talk over a long distance line, a certain part of this 3.5 must be reserved for long distance connections. It has been found to be sufficient to set aside 1.5 for this purpose leaving 2 for a local connection. The particular item to be determined in the problem under consideration is the permissible length of a subscriber's line to obtain good speech transmission. This line is included in the above 2 or rather in one half of 2, as there is one subscriber's line at each end. Outside of the two lines the 2 embraces also the loss in the subscriber's stations, in the office apparatus involved in the connection, and whatever there is of reflection losses. The part to be allotted to each of these elements could be determined, but as the systems of operation differ and therefore entail a great variety of circuits and apparatus, it becomes necessary to determine the part of the attenuation measure for each of these circuit elements for each system of operation besides an allowance for the reflection losses. This, however, would lead too far for our present purpose, and therefore a value of 0.4 will be allowed for all these losses outside of the line losses, leaving 1.6 for the two subscriber's lines or 0.8 for each line.

Attenuation Constants for Various Wire Sizes.

The next step is to ascertain the attenuation constant for the different sizes of wire used in transmission. The attenuation constant depends, as is well known, on the characteristics of the line, which are resistance, capacity, inductance and leakance. The deduction of the values of the attenuation constants is not intended here; they will be stated only in general for the cable gages with a capacity for cables of 0.0714 m. f. per mile. Open wires are still employed for subscriber's lines in sparsely settled districts and in toll and long distance lines; therefore their attenuation constants are recorded also. The attenuation values given for open wires are calculated for a leakance of 0.3 micrompos per mile and are for copper wire.

CABLES

Wire gage	Attenuation constant per loop mile.
No. 16 BxSG	0.094
" 19 "	0.125
" 22 "	0.18
" 24 "	0.22

OPEN WIRE

Wire gage	Attenuation constant per loop mile.
No. 8 B.&S.G.	0.0062
" 9 "	0.0079
" 10 "	0.0098
" 12 "	0.0124
" 8 B. W. G.	0.0042
" 12 N. B. S.	0.0086

As the attenuation measure "b" equals the product of attenuation constant into line length, this line length is easily determined for the various sizes of wires by dividing the previously found permissible attenuation measure, namely 0.8, by the attenuation constant for each wire gage.

For cables the following transmission range is obtained:

For No. 16 B.&S.G. $\frac{0.8}{0.094} = 8.5$ loop mi.

" " 19 " $\frac{0.8}{0.125} = 6.4$ "

" " 22 " $\frac{0.8}{} = 4.5$ "

$$\text{For No. 24 B.\&S.G.} \quad \frac{0.8}{0.18} = 3.6 \text{ loop miles}$$

$$\text{" " 24 " } \quad \frac{0.8}{0.22} = 3.6 \text{ "}$$

Open Wires:

$$\text{For No. 8 B.\&S.G.} \quad \frac{0.8}{0.0062} = 130 \text{ loop mi.}$$

$$\text{" " 9 " } \quad \frac{0.8}{0.0079} = 100 \text{ "}$$

$$\text{" " 10 " } \quad \frac{0.8}{0.0088} = 118 \text{ "}$$

$$\text{" " 12 " } \quad \frac{0.8}{0.0124} = 65 \text{ "}$$

$$\text{" " 8 B.W.G.} \quad \frac{0.8}{0.0042} = 190 \text{ "}$$

$$\text{" " 12 N.B.S.} \quad \frac{0.8}{0.0086} = 93 \text{ "}$$

To apply these figures for a single office plant a map on which the proposed cable routes are laid out by the development study, can be used, and around the office draw the boundary limit for each size of cable. Then in the limit for No. 24 gage cable, which will be the limit nearest to the office, the subscriber's lines must not exceed 3.6 loop miles measured along the cablerun. The next limit will be for No. 22 gage cable; the subscriber's lines must not exceed 4.5 loop miles. Up to the third limit for No. 19 gage cable the loop length must be less than 6.4 miles. No. 16 cable is not used for subscriber's lines, but may be used for long distance lines.

Open wires can be employed up to the 40 mile limit for No. 12 B. & S. G. Smaller gage wire is mechanically too weak for open lines considering snow, sleet and wind loads.

Choosing Gage of Trunk Line Conductors.

For a multi-office telephone plant trunk lines have to be taken in consideration. They may be taken care of by finding for each office the attenuation measure for the longest trunk line going out from this particular office and subtracting one half of this attenuation measure from the value of the permissible attenuation measure 0.8 before dividing by the attenuation constant. The gage of the trunk line conductors must be so chosen that the remainder of 0.8 after subtraction will not become too small. If necessary the trunk line must be loaded or repeatered. But such will be rarely required except perhaps in agricultural districts. In each case, however, careful calculations have to be made. Each problem must be considered individually according to the local conditions, the present discussion serves only to point the way.

The invention of the electronic tube has also changed the methods of loading. A few words of explanation will be illustrative. An electric wave propagating along a long line, when arriving at a point where the character of the line changes, that is, where the construction changes or some kind of apparatus is inserted and thus a change occurs in the characteristic impedance of the line, part of this wave is reflected and returned to the place of origin, where it is again partially reflected. This process continues until the steady state of transmission is obtained. In open wire lines of several hundred miles this steady state is quickly reached and the reflection currents are hardly noticeable. If a repeater is inserted into a long line, the reflected currents become decidedly noticeable and are audible as a distinct echo, for this reason they are termed "Echo currents." At repeater points the echo effect becomes pronounced in consequence of the difficulty of making the line impedance identical with the repeater impedance at all frequencies. To reduce the echo effects it is expedient to shorten the reverberations of the echo by speeding up the transmission, then the irregularities are rendered less noticeable.

As an unloaded cable circuit consists mostly of resistance and capacity, the efficiency of transmission varies considerably with varying frequencies; loading the cable reduces the variations. Therefore all cable lines containing repeaters should be loaded. With open wire lines it is different. Such lines are easier to balance than cable lines and their attenuation is less depending on the frequency. The velocity of propagation over the unloaded open wire line is higher than when loaded, consequently there is less reverberation of echo. Considering furthermore that it is cheaper to install a repeater in a long open line than loading it, it seems the days of loaded open wire lines are counted.

In loading cables it has been customary to apply three weights, namely heavy loading with about 0.2 heavy per coil in the physical side circuits and a spacing of 1¼ miles between coils; medium loading—0.1 heavy per coil and 1¾ mile coil spacing; light loading—0.05 heavy per coil and 2½ mile coil spacing. The introduction of repeaters has added two more weights: Medium heavy loading with coils having an inductance of 0.175 heavy in the side circuits and a spacing of about 6,000 feet between coils; extra light loading with coils of about 0.044 heavy for the side circuits and also 6,000 feet spacing.

All loaded lines have a cut-off frequency, that is, a frequency at which alternating currents can not pass any more through a line or better stated a frequency at which the attenuation measure of the line becomes extremely high. The cut-off frequency of medium heavy loaded side circuits is at about 2,800 cycles per second, and of extra light loaded side circuits at about 5,600 cycles per second.

Extra Light Loading Preferable on Very Long Lines.

On very long lines with repeaters, say over 600 miles, extra light loading is preferable. The lower inductance gives more nearly equal attenuation of currents at different frequencies and higher velocity of propagation, hence weakens the effects of the echo currents. Moreover the high cut-off frequency will keep down the transient effects, which are a peculiarity of long circuits and are apt to cause considerable distortion of speech. On shorter lines with extra light loading the transient periods are greatly reduced and consequently the currents are very little distorted. On short lines, however, medium heavy loading is more economical, because the inductance is distributed over fewer coils and fewer repeaters are required on account of the lower attenuation.

Repeaters of the latest type are very compact. Their appearance is very much like the old style magneto telephone without the transmitter arm. As many as twelve of them can be mounted on an iron frame about 9 feet high and 3 feet wide.

Cross Talk Also Furnishes a Problem.

Rendering echo currents and transients harmless is not sufficient to protect the speech transmission against disturbing influences, the cable itself and the loading coils have also to carry their share of the burden. In a cable a comparatively large number of circuits are closely associated and parallel each other over considerable stretches. The currents in the conductor pairs act upon each other principally at repeater points where not only the currents themselves but also any crosstalk currents will be amplified. Crosstalk will appear much easier on loaded lines. The problem of preventing or at least reducing crosstalk is solved by proper transposition. In cables this means symmetrically twisting of the two conductors in a pair, and where "quadformation" is used, also symmetrical twisting of the pairs.

The electric coupling of a system of four conductors may be expressed as four partial capacities so arranged in a Wheatstone bridge scheme that they balance each other. This can be put in practice by making the cable splices so that the capacity unbalance of a circuit in one cable section is counter-balanced by the capacity unbalance in the opposite direction of a circuit in the cablesection to be joined to it.

To effect this two methods have been

applied. In this country the conductors in adjacent cable sections have been connected so as to render the coupling as small as possible. It is very difficult, however, to obtain a good balance in that way; moreover in cables with a small number of pairs the possibility of balancing is limited; the cables joined by

Fig. 1—Method of Inserting Condensers.

this method are also hard to maintain as the order of the pairs is disturbed or changed.

Siemens and Halske of Berlin have introduced a balancing method by inserting suitably proportioned condensers. Thereby the couplings in the entire coil fields are eliminated. One set of balancing condensers for each coil field is sufficient. These condensers which are of very small dimensions, are inserted at the cable splices. Fig. 1 illustrates the method of insertion; Fig. 2 and Fig. 3 respectively the completed splice with and without cover.

In cables containing four-wire circuits at the points where the power going in one direction is a maximum, the power going in the other direction is a minimum. Therefore to avoid or at least to ameliorate crosstalk all conductors carrying power in one direction should be collected together and also the conductors carrying power in the other direction, and the two groups should be shielded and separated electrically from each other as far as possible.

The design of loading coils has been improved by using ironduct cores in place of the iron-wire cores. The new type core is very compact and possesses a smaller strayfield than the old one. Being of toroidal shape it requires less wire for its windings and consequently is cheaper to build.

"Pleijel" Coils for Quad Loading.

Another improvement has been made lately in coils for quadformation cable circuits by Professor Pleijel of Stockholm. At each loading point he inserts only one pair of coils in the two physical circuits whereby he loads the two physical circuits as well as the phantom circuit is such a way that the three circuits obtain the same attenuation constant.

E. Schuerer* describes the arrangement of the Pleijel coil as follows: "The two spools of each pair carry on each half of their ring shaped core one half of a winding which is to constitute part of one side of the physical circuit. The winding is put on in such a direction that a closed magnetic field is produced in the cores by means of the talking currents flowing in opposite direction. Thus the coils act the same as ordinary loading coils as far as the physical circuits are concerned. But for talking currents in the phantom circuit which are of the same direction in the sides of each physical circuit the magnetic fields in the coil halves are directed against each other; hence they combine where the winding halves meet and pass out of the cores as stray fields. The stray fields of the coils intermingle and thus constitute the phantom field of the pair. This action takes place in the interior of the two cores in consequence of attraction of the coil poles facing each other, and is increased still more by the neutral inductance of the two coils, so that it may be utilized for loading the phantom circuit. As at the transition points from core to core the phantom field would meet with a comparatively large magnetic resistance, iron steps of corresponding cross section are inserted between the cores at such points, for which purpose a corresponding part of the core between the winding halves is left free.

Distances Over Which Repeaters May Be Employed.

About a year ago Dr. Wagner and the writer presented in the Telephone Engineer a paper on Telephone Transmission over long distances, wherein the different repeater circuits, namely the 21-type (2 wires, one tube); the 22-type (2 wires, 2 tubes) and the 4-wire type were outlined. Therefore a general conception of these types is presupposed. Of interest to the reader in the present discussion is the distance over which the various repeater circuits can be applied advantageously.

As all repeaters work in one direction only, it takes two repeaters to talk both ways, one in each side of the line, the one acting in one direction and the other one in the opposite direction. This is done in the 22-type repeater circuit; but this circuit has its limits, not more than six repeaters of this type should be used in tandem; after that the four-wire type is to be used. In this type one circuit with 21-type repeaters works in one direction and a separate circuit with 21-type repeaters works in the other direction, the two circuits join at the two ends by means of a hybrid coil to the continuing 22-type line.

The efficiency of the various types of long distance lines is the following: Unloaded open wire lines of No. 8 copper wire can by the aid of repeaters cover almost any distance. On loaded cable lines below a distance of 600 miles the 22-type of repeater circuits are most economical. In these circuits using No. 19 cable the repeaters are placed 50 miles apart, the maximum length of circuit not to exceed 300 miles. The length of circuit or distance can be extended to 600 miles by using No. 16 cable with a repeater distance of 100 miles.

Above 600 miles the 4-wire type repeater circuit must be recurred to. For

Fig. 2—Completed Splice without Cover.

Fig. 3—Complete Splice with Cover.

No. 19 cable the repeaters are spaced about 90 miles apart.

*Das Fernsprechen in Weitverkehs, Nov., 1923.

F. Clark Durant, Jr., Promoted to Presidency of Keystone Co.

Philadelphia, Pa.—Following the monthly meeting of the directors of the Keystone Telephone Co., announcement was made that Percival E. Foerderer has been elected chairman of the executive committee, while F. Clark Durant, Jr., formerly vice-president, was promoted to president. Joseph F. Stockwell was elected executive vice-president, but will continue to direct the general management of the company. Gerald Ronon was appointed attorney of the company, succeeding the late James Collins Jones. Nathan T. Folwell continues as chairman of the board. Thomas Shallcross, Jr., was elected a director to fill a vacancy.

Similar executive changes were made in the officers of the Keystone Telephone Co. (of New Jersey), the holding company, and in addition Thomas Shallcross, Jr., was elected to the board to fill a vacancy. Mr. Durant was also made president of the Eastern Telephone and Telegraph Company and Mr. Stockwell vice-president and general manager, former president, continuing as a director. Clayton E. Platt was elected to the board to fill a vacancy.

Mr. Durant reported to the board that the financial affairs of the company were in excellent shape, and that the earnings after total interest showed an increase of $29.083 for the quarter, and for the twelve months' period an increase of $71,119.

The regular quarterly dividend of $1.00 per share on the no par preference stock of the Keystone Telephone Company of Philadelphia was declared, payable June 1st to stockholders of record May 15th, 1925.

Americans will not wait

Accustomed to instant communication by telephone and telegraph, our military authorities realized in the late war that the American Expeditionary Forces could not depend on the communication services of Europe.

The necessary plans, materials and engineers were sent over in ship loads. A world record was made by the Signal Corps in establishing lines of communication indispensable to every branch of the army. In a surprisingly short time, every American general in France had at his instant disposal the communication facilities and service to which, in America, he had been accustomed.

Europe was sometimes startled by the amazing methods of the telephone workers from overseas. The American-trained Signal Corps units invariably sought the shortest way, overcoming all natural obstacles to extend the needed means of communication.

The Americans were not content to wait. They expected and demanded the same ever-ready telephone connections which they had at home. The Bell System has set a world standard for prompt attention and continuous service.

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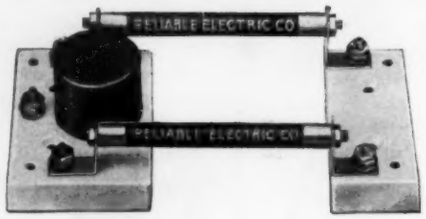

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Financing Plans Feature California Meeting

Los Angeles, Cal.—California's plan of unified financing of Independent telephone companies, worked out by the state association and given the endorsement of the state's financial authorities, now is ready for use. Charles A. Rolfe, re-elected president of the California Independent Telephone Association, in his presidential address made before the annual meeting of the organization at Los Angeles on April 24, advised making use of the association's service so each company requiring fair rates and other help in order to make use of the financing plan would be given valuable co-operation.

The presidential address also referred to the contact maintained with the state commission's staff and explained the "Foreign Exchange Service" rate that several Independent companies have been asked to make. An extension of the association's activities along the lines of the successful plant conference held last November was suggested by President Rolfe.

The following specific recommendations of association activities were further listed by the California chief:

1. An office be established in Los Angeles.

2. An assistant to the secretary be engaged to have charge of office in absence of secretary.

3. An attorney be retained to care for all matters coming before state railroad commission; to work with and assist the secretary.

4. A supply department be established for furnishing material and apparatus, on a percentage of cost basis.

5. An insurance department to furnish this service under the "blanket plan."

6. A financial department to market member company securities.

7. Last, but not least, have observers at all hearings of the commission to correct any misstatements or mistakes made by any company which does not avail itself of the association's facilities for service.

The convention acted upon giving broad publicity to the code of ethics adopted from the U. S. Independent association's suggestion of such a code.

Joint pole use got considerable attention from the Californians. A committee report indicated satisfactory progress in working out a mutually satisfactory solution of the problem concerning joint use of poles. The Southern California Edison company's representative pledged co-operation in affecting a speedy solution and J. E. McCaffrey of the commission spoke on the requirements of the law concerning construction and inspections.

Messrs. Rowe and Mess, the commission inspectors, who have been assigned to the Independent inspection, were introduced to the convention. Tribute was paid to the work of the commission men by A. Terkel, Carl H. Lorbeer and James S. Campbell, who recited their experiences with the inspectors.

Details of the association's busy year were related in the report of Secretary Earnest Irwin. Almost a third of the association's work, said Mr. Irwin, was connected with appraisals, accounting and preparation of cases before the commission. Growth and standing of the association was shown in the Irwin figures which placed the organization as representing 90,000 stations as against 50,000 not in the association. Of the member companies 25 average 462 stations each, and 12 average 4,690. Of the companies not members 77 average 124 stations each and 6 average 6,435.

W. J. Dodge, telephone engineer for the California commission, and J. L. Adams of the Pacific T. and T. Company were among other featured speakers on the program. W. B. Carteret advised companies not to hold commissions responsible for all rules not agreeable to subscribers.

LINE AND DESK

A PLANT MAN'S SAY "ON DOGS"

"The dog is man's best friend; he remains true in sickness and in health —in good fortune and bad—even unto death; and after death he will lie sorrowing on his master's grave."

BUT

when an honest man in the pursuit of his duty is met at the gate by barking, snapping dogs, the friendship would seem to have ceased.

Those in our business and in other businesses, whose duty takes them into private grounds or even along public roads in the outlying sections, find that more and more an important phase of education is the placating of barking dogs.

Far be it from me to say "there oughta be a law," for a well-bred dog is a companion and a protection, where protection is necessary, but some of the dogs we meet in the course of our travels penned up in small yards or running at large, should never have been allowed to live past the puppy stage, and these are the dogs that worry the general public most.

We do not suggest that a Constitutional Amendment be drawn up and ratified to govern the keeping of dogs, but we do believe that the public would see the light through an educational campaign, and then this barking snapping nuisance "shall perish from the earth."—P. A. Gardner in "The Transmitter."

PUBLIC OWNERSHIP

In Berlin they tell the story of a German who in the days of the slipping mark came bustling into a fashionable restaurant with a big valise crammed with bank notes.

"Hooray," he cried, "I've got a job on the government railroad, and here's my first day's pay."

"What kind of a job is it?" he was asked.

"Well," he answered, "you know there's a chap at the station who goes the length of the train tapping the axles with a hammer to see if everything's all right?"

"Yes."

"Well, I'm his listener."—"The Transmitter."

POLE AUGER BUSY IN STORM REBUILDING.

With 500,000 new poles to set, to replace those destroyed in the great sleet storm, many of the telegraph, telephone, and power and light companies in Illinois have introduced machines which dig holes in a few seconds, doing the work that requires the services of several men for an hour. These machines operate a gigantic auger, operated by a gasoline engine and each machine can do as much work as thirty men. The saving in time and cost is especially noteworthy during the present winter when the ground is frozen and digging by means of shovels, slow and laborious. As rapidly as the holes are dug by the machines, derricks, mounted upon trucks, hoist the poles aloft and they are lowered into the opening. A few men can now do as much work with these machines that formerly required two score, and there is heavy saving in time for the great utility corporations.—E. E. Pierson, Bloomington, Ill.

Digging pole holes with this machine is a soft job

MULTIPLE CABLE DISTRIBUTION

A subscriber asks us to recommend a book, covering principles of multiple cable distribution in a thorough manner. Unfortunately we are not able to recommend any specific text book which covers this subject in a complete manner. References will be found in "Telephony," by McMeen and Miller, and in some other texts but in no case is the treatment as complete as could be wished. A number of excellent articles have appeared on the subject and, particularly we can recommend, articles that have appeared in TELEPHONE ENGINEER by Charles W. McKay in his series "Practical Plant Problems" and by E. K. Goss on "Economical Cable Plant" in July, 1924 number. The article by Mr. McKay in September, 1922 deals with the problem in an excellent manner and is worth careful study. Unfortunately, through a slip of the make-up man, the drawings which should have accompanied Mr. Goss' article were omitted and we have not yet been able to locate them. If found, they will be reproduced in a later issue.

Discussing the matter briefly, it may be said that there are two reasons for multiple cable distribution, to obtain greater flexibility of the plant and to

provide for party-line distribution. The general tendency at the present time is to use cable terminals freely in order to reduce the open-wire and twisted-pair distribution. The distributing cables usually are treated in sections of 50- or 100-pairs, with a certain amount of multipling of the pairs into the terminals. The amount of multipling depends upon the relative proportion of individual and party-line subscribers, fill of the cable desired, method of obtaining relief and other factors. A number of systems of multipling have been developed but some engineers favor only a very elementary system, preferring to work out the multiplying scheme for the particular case based upon their block studies of the area to be served. Perhaps some of the outside plant engineers among the readers of TELEPHONE ENGINEER can give us a new article dealing with this subject.—Staff Contribution.

EVEN TREE TRIMMING DEPENDS ON "GOOD PUBLIC RELATIONS."

If one is to talk about tree trimming, it is best not to enter deeply into the technical side of it, perhaps. There are 713 different ideas on the subject. Each property owner abutting our toll leads has a different idea and the foresters do not always agree with them. The general methods of good tree trimming however, are the same as those specified and practiced by the telephone people.

The thing to do is to trim correctly and, at the same time, please the public. The abutting property owner does not always know what is best for his trees. For instance, he may wish a tree "topped" or headed back when it needs only a "U" shaping for clearance. True, the topping makes a tree look better for a time, but it will eventually injure or kill the tree. The trimmers must save all good limbs not interfering with the wires and educate the property owner to the proper type of trimming. Above all, we must please the public. Whether or not we trim depends upon their good will.

Obtaining permission to trim is the most difficult part of the work at times. If the last trimming crew pleased a community, there is no difficulty in obtaining permission to trim again. If the last crew did not please, the going is likely to be rough. We should make every effort to right any imaginary or real wrongs suffered by property owners at the hands of past trimmers.

Sometimes people withhold trimming permission on the grounds of some fancied or real grievance. Maybe they think their service is poor; maybe someone has set an "anchor" in their meadow without asking permission. Such things make trimming difficult. In the same way, poor trimming may make the going rough for some other department. It seems to me that each department should strive to incur the good will of the public for the good of all other departments as well as for its own good.

In the trimming game we must gain the confidence of the public. Honesty and courtesy are great aids. If the property owner gives permission to cut out a few twigs and we cut out whole limbs, he will come to distrust us. We must look at the trimming from the other fellow's viewpoint as well as our own. What would we do if we were in his shoes?

The so-called "personal touch" does much to gain public support. I had an experience illustrating this. An elderly lady said, the first time I asked her for permission to trim her trees, that she would not allow me to even cut out dead stubs. I called on her about twelve times after that and we discussed everything from the family washing to world politics. She wanted to know my name, age, nationality and address.

I finally convinced her that we would do her trees more good by cutting out dead wood, than harm by get-

KRAEUTER & CO.

Diagonal Cutting Pliers. No. 2601, 6 in. $1.65

Radio and Switchboard Pliers. No. 1561, 6½ in., $2.00

Kraeuter Lineman's Pliers, No. 2801, 8½ in., $2.75

EVERY pair of Kraeuter Pliers is hardened with extreme accuracy.

Their cutters are *hard* but not brittle.

Their rugged lap-joints *fit close*, and hold the cutters true.

Every pair is tested at the factory for *strength*, *toughness* and *cutting power*.

KRAEUTER PLIERS

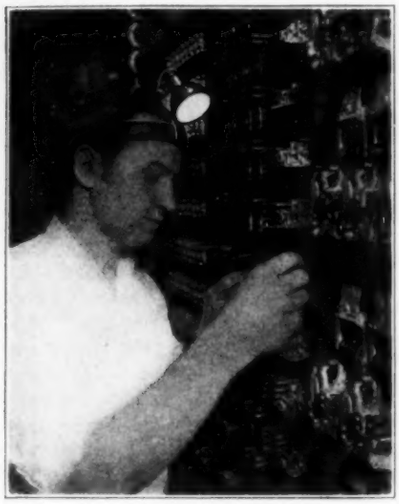
KRAEUTER & CO., Newark, N. J., Established 1860

ting clearance, and she allowed me to trim the trees. I am corresponding with her now and have promised to "drop in" at "strawberry time."

In the trimming work we must keep all our old friends and make new ones.—H. R. Bigford in "The Mouthpiece."

A CONVENIENT TROUBLE LIGHT.

A convenient light for use of switch board repairmen and installers is described in a recent number of "Western Electric News." The inspiration for the idea came from the automobile trouble lamp which may be clamped on the dash, running board or other place on the car where light is needed. This idea, combined with the idea of the miner's headlamp, offered the solution of one of the troublesome problems when an equipment man is working in close quarters, namely:



This makes work light for repairmen.

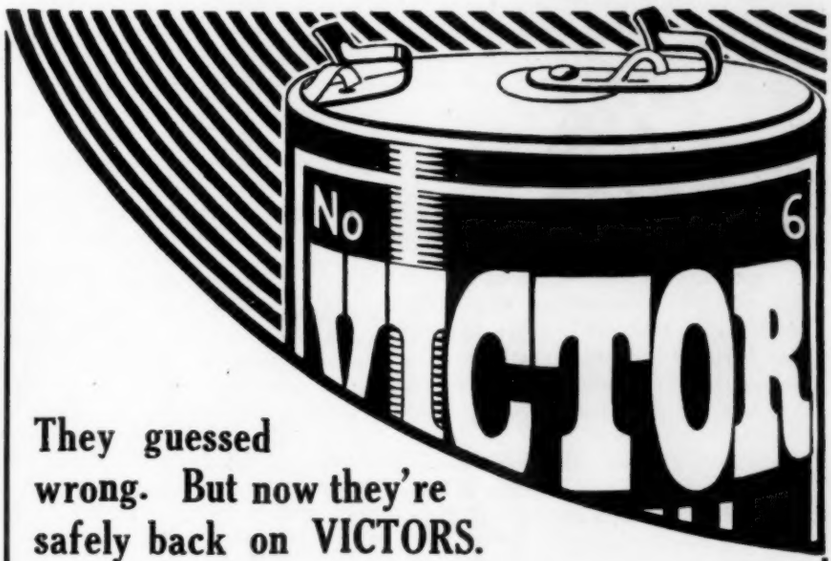
the problem of getting adequate light on the work. The new light consists of a leather cap, which is adjustable as to size, and an aluminum reflector. An asbestos shield keeps the heat of the lamp from the operator, and the sharp light from his eyes. Either a 24-volt or a 48-volt bulb can be used. With the light shining from his head the workman gets the illumination just where he needs it without any chace of getting his head in the way. An additional touch of ingenuity was added when it was discovered that an unpleasant jerk of the head resulted if the light was forgotten and a quick turn made. A jack which will release very easily was placed in the cord and now, if an operator whirls around suddenly, he merely disconnects the cord.

"BUGS WE HAVE SHOT"

One day a number of calls were received from a four-party line on a magneto exchange but no one was on the line when the operator answered. A test showed three parties O. K. while the fourth did not answer. When I went to the house, I found the telephone dead and inquired about the batteries. The young lady who was at home said they were in the basement, so I went down to look them over.

I found the wires but no batteries. Finally they were located and when I connected them again the trouble was clear.

When I inquired as to the cause, I learned that the lady of the house had been annoyed by boys ringing the door bell and had taken the batteries off thinking the door bell worked from them. She wondered how the boys still could ring the bell and an investigation showed that the door bell rang from a bell-ringing transformer on the electric light circuit.—Contributed.



They guessed wrong. But now they're safely back on VICTORS.

A letter on file in the office of a Victor battery distributor tells of the experience of an Ohio telephone man.

He says he bought his plant from a company "that had been using Victors practically altogether."

Under the new ownership the battery brands were switched. After ten months the new owners found they were just getting to replacing the Victor batteries placed in telephones more than a year previously by the original owners.

Naturally, the new owners seeing the evidence of this practical comparative test, now have contracted for Victor batteries for all of their requirements.

It cost money for the new owners to learn that Victors have the longest life, just as it is costing you money to determine what is the most economical and satisfactory telephone battery. Victor exclusive construction **assures** longer and livelier life.

You can put an end to this waste by making a comparative test in actual service of Victor batteries and any other brand. It's a saving that is important and easily made.

Write us for the name of your nearest Victor distributor and he will show you in detail why you should give Victors a chance to prove their superiority.

CARBON PRODUCTS CO.
LANCASTER, OHIO

Ajax Has Nothing on George for Defying Lightning

George Rodormer, secretary of the Reliable Electric Company, and one of the founders of this flourishing enterprise, was launched into business activity under flattering circumstances. George's first job was pay clerk on a pay-car of the Northwestern railroad. One look at his honest young map and the gent in charge of picking the help probably said to himself, "Here is a kid I can let be chummy with the company cash."

Naturally, as pay clerk, George's operations brought great joy to those with whom he did business, and established a precedent he has maintained in his present peddling of protection.

After some years working on the railroad Rodormer got into the retail cigar business and learned the ropes of that game so well that he impressed Frank G. Jones, president of the old American Electric Fuse Company, with his selling ability. For ten years Rodormer was with the American company traveling all over the United States and Canada selling telephone protective apparatus. In those days when the electrical jobbers handled telephone equipment George probably knew more electrical jobbers than any other man in the business.

In 1910 George left the American to form, with some associates, the Reliable Electric Company. July 30th, this year, marks the twenty-fifth anniversary of his entry into the electrical field, and on that date George plans to go out and break the course record at the Park Ridge Country club. He and his son have been close contenders for the Father and Son golf championship which is staged in the Chicago district annually.

REPEATERS FOR IRON WIRE LINES

A subscriber sends us the following query: "If possible I would like some information on vacuum tube repeaters for adding to the transmission distance of No. 12 iron wire."

In answer, we can say that we do not believe that it is practicable to use repeaters with No. 12 iron wire circuits. The transmission losses in No. 12 iron wire are such that commercial transmission can not be given over more than 100 miles of such circuit with the telephones connected directly to the ends of the circuit. When central office and local subscribers' lines are added, the distance will be much less. In all probability, it will be found that transmission complaints will be received more or less frequently if the lines are more than 50 or 60 miles long.

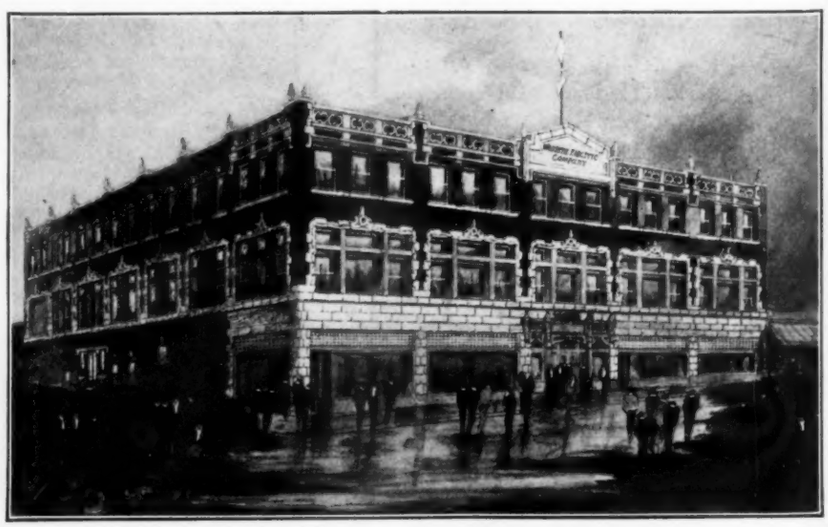
While the problem of amplification of voice currents has been solved in a relatively simple and satisfactory manner by the use of the vacuum tube, the application of the vacuum tube to two-way transmission requires a considerable amount of special equipment, some of which must be built to match the characteristics of the line with which the repeater is to be used. Variation in the characteristics of the line will throw the repeater circuit out of balance and will cause "singing" in much the same way as a whistling noise is caused when a receiver is held to the transmitter of a subscriber set. Such variations are more likely to occur in iron than in copper lines.

The most feasible plan for securing adequate transmission, where the line is too long for direct No. 12 iron, is to substitute copper. At the present price levels of copper and iron wire, when lengths of life and salvage value are taken into consideration, it will be found that there is little difference in the cost, in the long run, between copper and iron, and the superior transmission throws the advantage in favor of the copper. The substitution of copper for iron does not always mean the loss of the iron circuit which may still be maintained for short haul traffic, or used for relief of heavily loaded farm lines.

Blind War Vets Trained as Operators in England

London, England.—It may not be generally known that one of the most successful occupations taught to the blinded soldiers at St. Dunstan's is telephone operating, says the Electrical World of London. A large number of these men have found employment with important business firms and organizations in London and the provinces, and the freedom from outward distraction—a natural accompaniment of blindness—enables the blind operator to concentrate on his work to a much higher degree than is possible for a sighted operator, and thus he can maintain an excellent service. A point for British employers to bear in mind is that the employer's liability for his blinded soldier operator is no more than for an ordinary employe. To his employer he is a perfectly normal member of the staff. His special needs as a blinded ex-service man are the permanent and sole responsibility of St. Dunstan's After-Care Organization.

Western Electric's Kansas City Home



This fine new home at Kansas City the Western Electric Company now occupies as headquarters for the western division. At "the gateway of the mid-continent" there are the customary Western Electric stocks carried.

DEPENDABLE
From the Start—1904

RUNZEL-LENZ
ELECTRIC MANUFACTURING CO.

Manufacturers of

Telephone and Switchboard Cords

Central Office Operators Cords

Radio and Wireless Cords

Tinsel and Copper Conductor Cords — All Kinds

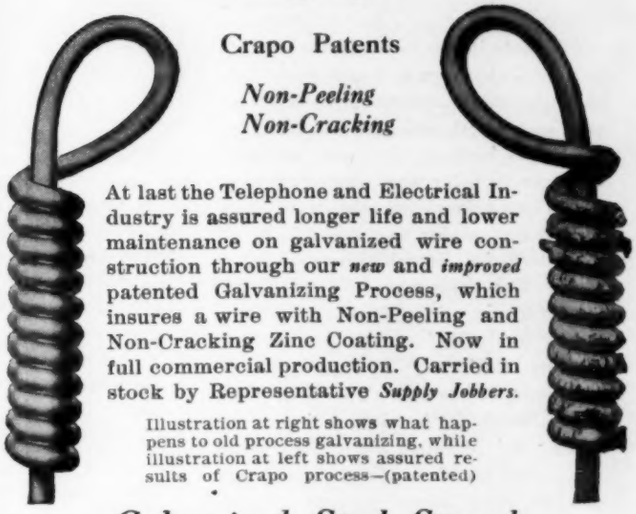
Wire — Silk and Cotton Insulated for Wiring Telephones and Switchboards

Flame Proof Jumper Wire

Cables—Silk and Cotton Insulated—Both Braided and Lead Covered Types

RUNZEL-LENZ
ELECTRIC MANUFACTURING CO.
1751-57 North Western Ave.
CHICAGO

"INDIANA"
Double Galvanized Telephone and Telegraph Wire



Crapo Patents

Non-Peeling
Non-Cracking

At last the Telephone and Electrical Industry is assured longer life and lower maintenance on galvanized wire construction through our *new* and *improved* patented Galvanizing Process, which insures a wire with Non-Peeling and Non-Cracking Zinc Coating. Now in full commercial production. Carried in stock by Representative *Supply Jobbers.*

Illustration at right shows what happens to old process galvanizing, while illustration at left shows assured results of Crapo process—(patented)

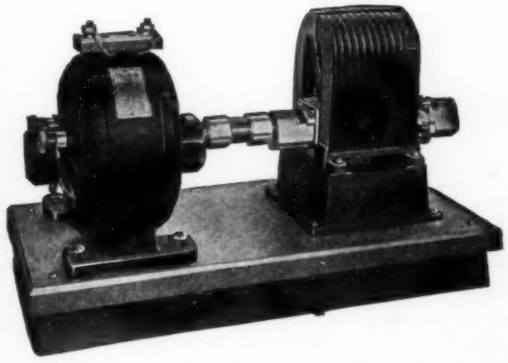
Galvanized Steel Strand

Standard or Commercial, Siemens-Martin, High Strength and Extra High Strength Grades

Indiana Steel & Wire Co., Muncie, Ind.

Dependable Ringing Service —with Economy!

A Holtzer-Cabot Magneto Ringing Motor-Generator



is the ringing equipment that NEVER FAILS. It is uniformly dependable—and economical in first cost and in upkeep. It needs no costly attention — if properly lubricated.

Send for illustrated circular. Or, better still, give it a test in your exchange, we stand back of the machine.

THE HOLTZER-CABOT ELECTRIC COMPANY

Boston Philadelphia Detroit New York
Chicago Minneapolis Baltimore Cleveland

BRACH
VACUUM ARRESTERS

at prices within your reach

When the best protection costs no more, why not have it? BRACH arresters insure; non-grounding of lines, cables, clear transmission, balance of potential between pairs, and full protection against power crosses or lightning. There are no carbons to clean and no maintenance bills.

You can readily afford BRACH Vacuum Arresters at our present low prices. Type 440, shown above, is furnished with porcelain base, fuses and mountings.

L. S. BRACH MFG. CO.
NEWARK, N. J.

Strength of Concrete Poles

Test Tells Story of How Concrete Poles Fail Under Load

STAFF ARTICLE

Strength tests of concrete poles recently made in the yards of the Indiana Service Corporation at Logansport, Indiana, give some interesting facts in regard to strength and design features of reinforced concrete as a pole material. Two sample poles were made under observed conditions and the tests were carried out under the supervision of Harry O'Brien, Superintendent of Overhead. The poles were of rectangular section having dimensions of approximately 9⅝" x 8¾" at the ground line, tapering uniformly to approximately 6" square at the top. The poles were approximately 30 feet long and were set so that 25' projected above the ground line. One sample made about one and one-half years before the tests, had six reinforcing rods arranged in two rows of three rods each along the narrower sides of the rectangle. The second sample, which was about 3 months old, had eight rods arranged in rectangular formation along the four sides of the pole.

The poles were set in large blocks of concrete several weeks before the tests so that the conditions approximated those found in service where the poles are set in pavement. Load was applied by a set of large blocks attached to a guyed pole some distance from the poles under test. The line was attached to the pole at a point 24 ft. above the ground line in such a way that the pull was horizontal. The load in pounds was read on a dynamometer in the line between the top of the pole and the pulley blocks. Deflection of the pole top was read on a graduated rod handled by a lineman on a nearby line pole. Both poles were loaded until failure occurred and the poles were pulled completely over.

As the load was applied, a considerable deflection occurred at the top and small cracks appeared at the base of the pole on the tension side. The actual failure of the pole occurred, however, by the crushing of the concrete on the compression side and the maximum pull required was exerted just before the concrete failed. After the concrete failed on the compression side, the pull required to pull the pole completely over decreased rapidly. The final failure came when the reinforcing rods on the tension side failed by breaking and the rods on the compression side by bending. The concrete was broken into small pieces as shown in the illustration.

Detailed calculations of the stresses at failure were made by Messrs. A. W. Faris and J. P. Conner, senior engineering students of Purdue University, the results of which are given in the following table:

	Old type pole	New type pole
Dimensions at ground line	9⅝" x 8¾"	9⅝" x 8⅞"
Height above ground line	25'	25'
Height to point of application of load	24'	24'
Maximum load	1285 lbs.	1865 lbs.
Compressive stress in concrete at maximum load	2665 lbs./sq. in.	3920 lbs./sq. in.
Compressive stress in steel at maximum load	16,500 lbs./sq. in.	23,200 lbs./sq. in.
Tensile stress in steel at maximum load	56,800 lbs./sq. in.	72,500 lbs./sq. in.

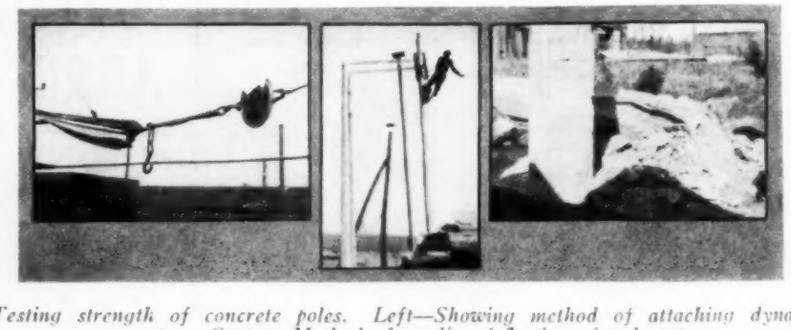
The new type pole showed a considerably greater strength than the old pole. This was undoubtedly due to the fact that more care was used in obtaining a good quality of concrete and in curing the pole. The calculated crushing strength of 3920 lbs./sq. in. indicates that an excellent grade of concrete was used. It is probable that the maximum tensile stress in the reinforcing rods as shown by the computations does not represent the maximum stresses that actually occurred as the figures are somewhat below average tensile stresses at failure, particularly in the case of the old type pole. This discrepancy is probably due to th efact that the maximum tensile stresses in the steel rods did not develop until after the concrete was crushed by the application of the maximum load at the top of the pole.

The following statements summarize the conditions of failure and maximum stresses:

1. The poles failed at or near the base due to the crushing of concrete on the compression side.

2. Until the concrete failed by crushing, the load was carried principally by the concrete and the maximum load developed just before crushing took place.

3. After the concrete was crushed, the load was carried by the reinforcing rods on the tension side and final failure took place by the breaking of these rods. The load required to break the rods was less than that required to crush the concrete so that the pole may be expected to break down entirely when a load in excess of that required to crush the concrete is applied.



Testing strength of concrete poles. Left—Showing method of attaching dynamometer. Center—Method of reading deflection of pole top. Right—Showing how concrete was broken.

Stromberg-Carlson Report Shows Fine Growth

Rochester, N. Y.—An amazing story of a steady growth from a small concern, whose very existence was considered precarious for a time, to a leader in its field with three-quarters of a million dollars profit in 1924, is that of the Stromberg-Carlson Telephone Manufacturing Company.

Dividends totaling 11 per cent on stock, the par value of which was $2,000,000, were paid to stockholders during 1924. After payment of the dividends a surplus of $587,625.98 was added to the reserve.

It was in 1894, immediately after the expiration of the basic patents of the telephone, that Alfred Stromberg and Andrew Carlson joined company with but $500 backing them, to manufacture telephone apparatus.

The present company was organized in 1914 and in 1917 all notes of the organization were retired, and the capitalization increased to $1,000,000.

For the eight years just passed the success and expansion of the company has been rapid.

Membership "Drive" in Iowa

Thirtieth Convention Plans to Increase Membership and Organization Work

Des Moines, Iowa.—Under the leadership of M. A. Boyer of Woodbine, who was elected president of the Iowa Independent Telephone Association at its thirtieth convention held here, a vigorous drive for new members is to be staged. The Iowa association's thirtieth year finds the association in excellent shape in its executive personnel and qualified to have a complete representation of the state's telephone companies. With such nationally known figures as Charles Deering, the state's re-elected secretary, and Miss Anne Barnes, traveling chief operator, constantly on the job, the prospective members have a service available that should make the 100% ambition of the membership drive a fairly simple selling feat.

Radio again figured prominently in state convention proceedings due to the remarks made at the Iowa meeting by E. C. Blomeyer and L. M. Kraege of the Kansas association. Kraege told the telephone companies to tie into radio as distributors of standard radio equipment and of programs.

The presidential address of the retiring executive F. M. Boardman stressed the necessity of rates sufficient to create a reserve that will handle such storms as Iowa experienced in recent months. Mr. Boardman commended the building of offices privately owned by telephone companies as evidence of the strength of the utility enterprise. Promise of much good to come from the extension department of the Iowa State College was registered in the presidential address.

Secretary Deering's report summarized the legislative activities of the association, inductive interference cases and the achievements of the Iowa operators' and plant schools. Iowa's work in teaching operators was further commented on in the remarks of J. M. Plaister who told of Fort Dodge's work in teaching chief operators to properly instruct operators, and in the address, "The Operator's Responsibility," made by Miss Barnes.

"Our Inductive Interference Problems from an Electric Light Man's Viewpoint," according to Austin Burt of Waterloo, the speaker, were cheapest solved by the telephone companies. He said about 200,000 Iowa farm telephones are of the grounded type, and recommended representation of telephone companies on the bodies now planning to extend the use of electricity by farms. A lively discussion followed the Burt address.

Smaller telephone companies have been perilously behind the procession in advancing rates to a "sound, satisfactory and remunerative basis," said R. I. Wilder, commercial superintendent of the Tri-State of St. Paul, whose address on "Rates for Small Telephone Plants" was a convention feature. Small companies' organization services performed without charge, far too low depreciation reserves and a necessity of rebuilding at a much higher cost basis than that of the original plant are the dangers burdening the small company, Mr. Wilder stated. He also detailed the points in the present small exchange situation that are inimical to the subscriber. He cited how "just good, intelligent, reliable telephone men" were able to secure a living increase in rates by placing the cards on the table after taking over a moribund company. He outlined the principles of rate making and suggested a foresighted survey of financial requirements and team-work among the small companies as the first steps in getting proper rates.

H. H. Wheeler, Jr., chief engineer of the Lincoln T. and T., gave the convention a splendid practical talk on the "Relation Between Depreciation and Maintenance."

Officers elected at the Iowa meeting: M. A. Reed, secretary and manager, Boyer Valley Telephone Co., Woodbine, president; Fred G. Moore, manager, Washington Telephone Co., Washington, vice-president, and Charles C. Deering, Des Moines, secretary-treasurer.

Directors elected: Charles S. Hurmence, Sumner; F. M. Boardman, Nevada; M. Fretz, Harlan; O. L. Loudenslager, LeMars, and H. B. Melick, West Liberty.

WANTED

Assistant Wire Chief for our Franklin (Pa.) exchange. New Stromberg-Carlson feature equipment. New building; over 3,000 stations; no competition. Good, steady position for man with experience and thoroughly competent on switchboard maintenance and relay adjustments. Reply, giving age, experience and reference. Salary will be $125 to $150 per month to start with, according to ability of man selected. Petroleum Telephone Co., Oil City, Pa.

J. K. Johnston, Telephone Engineer

During recent years I have been privileged to appraise Telephone Exchanges all over the United States. The list totals 410. Would you like to avail yourself of my services?

903-4 Lemcke Building, INDIANAPOLIS

Valuations—Supervision—Plant—Inductive Interference—Expert Administrative Counsel for Utilities

JAY G. MITCHELL

TELEPHONE ENGINEER

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COFFEY'S

Central Accounting Department

Keeps the records and makes up all reports for companies (large and small) in 17 states. The cost is about half the salary of a bookkeeper. It will not cost you anything to inquire as to our plan, charges, etc. Write today.

Coffey System & Audit Co., Indianapolis, In
National Convention, Room 110

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Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies.

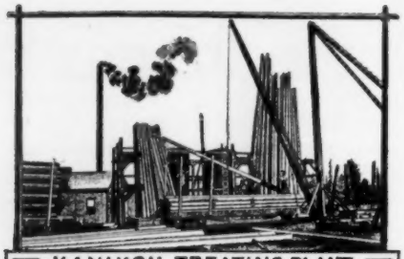
J. G. Wray, Fellow A. I. E. E.
Cyrus G. Hill
1217 First National Bank Bldg., Chicago

Rot's Terrific Toll Shown in C-A Preserver Folder

St. Louis, Mo.—C. A. Wood Preserver Company has issued a new circular which has as its theme the effect of C-A application in preventing the $206,812,000 annual waste which the government estimates is the toll of rot. Details are given of the present menacing forest situation, and the case is graphically presented by a reproduction of one of Darling's cartoons. The center spread of the folder is employed for showing in actual figures the results of C-A treatment, and a summary of the merits of the preservative. A copy of the folder will be sent on request by the C. A. Wood Preserver Company, 6229 Delmar Ave., St. Louis.

New Rectifier Has Many Improvements

East Pittsburgh, Pa.—A new type battery charger that will be suitable for use in charging radio and automobile batteries as well as for other applications has been developed by the Westinghouse Electric and Manufacturing Co. The new outfit is self-contained, all parts except the leads and terminal boards being enclosed in a sheet steel case. A heavy back plate supports the transformer which is impregnated in an insulating Japan. These features produce a moisture proof unit and one almost free from vibration resulting in a very quietly operating outfit. The transformer windings are all entirely insulated from the line.



KANIKSU TREATING PLANT

WESTERN RED CEDAR POLES

FROM THE
Kaniksu National Forest

All Styles of BUTT TREATING

KANIKSU CEDAR CO.

PRIEST RIVER, IDAHO

LOS ANGELES OFFICE
Harry G. Holabird - 451 E. 3rd St.
EASTERN OFFICE
F. C. Adams Co. - - Kingston, Pa.
DENVER OFFICE
Geddes & Aldom - 300 Int. Tr. Bldg.

KANIKSU RED CEDAR POLES

Everstick

Approved by Large Operating Companies For the Following Strains

6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
8" 2-way	6,000 lbs.
8" 4-way	10,000 lbs.
10" 4-way	16,000 lbs.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

For Quick Sale—225 Subscriber Magneto Exchange. Sixty dollars per station. Nets five hundred per month. Ten thousand cash. Any terms on balance. No competition. Last chance at this price. Address Telephone Manager, Nehalem, Ore.

London Telephone Kiosks to Be Works of Art

London, England.—The concrete structures erected in the streets by the post office as telephone kiosks failed, it seems, to satisfy local authorities. The post office accordingly applied to the newly-formed Royal Fine Arts Commission to arrange and judge a competition for a new design. As a result, a type designed by Sir Gilbert Scott, R. A., has been accepted, says the *Electrical World*. It will be constructed of cast iron sections assembled on the spot. The door and both sides have lattice windows, and there will be electric light inside.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

of Telephone Engineer, published monthly at Chicago, Ill., for April 1, 1925.
State of Illinois, County of Cook, ss.

Before me, a notary public, in and for the state and county aforesaid, personally appeared W. H. Graffis, who, having been duly sworn according to law, deposes and says that he is the general manager of Telephone Engineer and that the following is to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication, for the date shown in the above caption, required by the Act of Aug. 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, general manager and business manager are:

Publisher, Telephone Engineer, Chicago, Ill.

Editor, Herbert Graffis, Chicago, Ill.

General Manager, W. H. Graffis, Chicago, Ill.

Business Manager, Jos. M. Graffis, Chicago, Ill.

2. That the owners are (give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding one per cent or more of the total amount of stock):

W. H. Graffis, Herbert Graffis and Jos. M. Graffis, all of 28 E. Jackson Blvd., Chicago, Ill.

3. That the known bondholders, mortgagees and other security holders owning or holding one per cent or more of total amount of bonds, mortgages, or other securities are (if there are none, so state). —None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustees or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any person, association or corporation has any interest, direct or indirect, in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date above is..... (This information is required from daily publications only.)

TELEPHONE ENGINEER,
W. H. Graffis, Gen. Mgr.

Sworn to and subscribed before me this 26th day of March, 1925.
(Seal) C. A. LE ROY.
(My commission expires Oct. 4, 1926.)

Trailer Built to Cut Cost of Company Hauling

Fowler, Ind.—A sturdy trailer of unquestioned utility in helping telephone companies solve material transportation problems is being built by the Bower Mfg. Co. of Fowler. The equipment has been given thorough practical tests over a length of time amply sufficient to identify it as worthy of telephone company consideration. One of the interesting

Bowler Trailer for telephone company work

points about this Bower trailer is a remarkably low price which enables the smaller telephone companies to make more efficient utilization of their automotive equipment by hauling an extra large load with the trailer.

Details of the Bower trailer construction, given below, indicate a good, strong job. The specifications:

Bower trailers are made entirely of hardwood, thoroughly bolted together, and painted a durable dark grey. The sides of the body are removable by taking out three bolts on the side, while the wheels are regular Ford wheels with demountable rims, standard size, 30x3½, with regular Ford hubs and ballbearings. Ford springs are also used, meaning easy and convenient replacements.

The axle is of 1½-inch round chrome-nickel steel and is amply heavy to meet any emergency. The trailers are fully guaranteed to safely carry a 1,000-pound load at automobile speed.

Second Radio World's Fair at New York, Sept. 14-19

New York City.—The Second Radio World's Fair will be held here, in the 258th Field Artillery Armory, September 14 to 19. The 258th Field Artillery Armory is the largest building of its kind in existence. It is located at Kingsbridge Road and Jerome Ave. and its transportation facilities are ideal. A dozen subway, elevated, surface and bus lines pass the main entrance which also is on several of the best automobile routes.

FOR SALE

15 miles of new No. 12 Double Braid Weatherproof Iron Wire in ½-mile coils, at 6c per pound.

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Radio a Kansas Feature

Hustling Silver Anniversary of Kansas Association Puts New Service in Spotlight

Topeka, Kan.—Twenty-five pioneers who have been in Independent telephone work for 25 years or more lined up at the 25th annual meeting of the Kansas Independent Telephone association to give the more recent additions to the ranks convincing evidence that age could not wither nor time stale the Jayhawk spirit. And just to show that no atrophy of brain cells threatened at the quarter century mark a number of the Kansans related details of the tie-up with the radio that was being successfully made in the state by transmission to telephone subscribers of the programs received by the telephone companies' central stations' receiving sets.

An advisory commission was appointed by the association to confer with member companies desiring to develop this character of radio service. The address made by Ray H. Manson, chief engineer of Stromberg-Carlson focused attention on the teaming of the telephone and radio. The spirited discussion which followed this address produced some interesting tips from J. A. Gustafson of Fredonia, who pioneered this service in Kansas, President T. L. Youmans and Sam Pickard, director of the Kansas State Agricultural College station.

During the opening session E. L. Chase of Kansas City looked into the future of telephonic development, and the brief addresses of President Youmans and Secretary Kraege were presented.

In his remarks on "Playing the Game" R. L. Timmons, president of the Kansas Public Service Association, said, that in giving the average man a circle of influence of at least 25 people, there were approximately 500,000 people in Kansas who could be educated in utility matters by the 20,000 Kansas utility employees.

Miss Anne Barnes spoke in interesting detail on "Handling Telephone Service; Whose Responsibility?" Miss Barnes cited cases in small office operation where opportunities were afforded for betterment of service and economies.

A number of well-known utility men and legislators spoke extemporaneously at the Kansas affair. Among them were Jack Walton, former president of the Oklahoma telephone association, J. H. Ainsworth, engineer of the Kansas Public Utilities Commission, Governor Paulen of Kansas, L. T. Hussey, Chairman of the Kansas Public Service Commission and Commissioner Jesse W. Greenleaf.

A complete explanation of the Kansas compensation law and the responsibility of the Kansas telephone company under this law was given in the address of Judge John J. Crawford of the former Kansas Court of Industrial Relations.

Two public relations experts, H. Lee Jones, director of the Information Bureau of the Kansas Public Service Companies and Keith Clevenger, director of public relations of the Empire Companies, spoke on the development of public relations and cited instances where this work was being successfully conducted.

An absorbing and personalized story of the growth of the Independent telephone industry in Kansas was told by H. N. Faris of Kansas City, who referred to the achievements of two Kansans the late J. C. Kelsey and President F. B. MacKinnon of the U. S. I. T. A. as conspicuously responsible for the advancement of the cause. Mr. MacKinnon appeared in a bright spot on a program of features and delivered an inspiring address on "The Influence of Individuality and Personality as a Business Asset."

Several of the prominent Kansas telephone men spoke before the well attended operators' conference which was conducted during the twenty-fifth Sunflower state session.

In honor of the twenty-fifth anniversary of the association the convention was the guest of the Southwestern Bell at a banquet and entertainment during which a number of talented postprandial orators spoke. Carl Uffers of Topeka, general manager of the Southwestern Bell, was toastmaster at the banquet.

Headed by President T. L. Youmans, the 1924 executive ticket was re-elected with the sole change being the election of E. L. Chase of Kansas City as treasurer.

Order Fishing Is His Sport

John Jaap of the Cook Electric Company dates his debut in the telephone business from January 1913 when he returned from the Canal zone to go to work in the Cook plant which then was at Zion, Ill.

John is a native of Chicago and got his start as a business man, being assistant managing editor of his father's grocery store. Upon reaching the age when the wanderlust enters every youth's veins, John set forth for the Panama ditch and spent three years in the zone on the government payroll. During his hectic sessions in those parts he averaged a new job every eight weeks and figured in a multitude of activities ranging from acting superintendent of corrals and stables to acting yard master. He confesses that most of the work was acting with a lower case "a."

After two years in the factory for Cook Jaap was transferred to the sales department and in this connection acquired a host of friends by working as Cook's official conventioneer. In this particular activity John has traveled a beat equivalent to twice the distance between the earth and Saturn and at the same time managed to keep his wife reconciled to his prolonged and frequent absences, thus demonstrating no mean degree of oratory.

In the summers, during the time John gets to stay near Chicago, he moves his domestic menage out to one of the small lakes near Chicago and commutes daily to the Cook headquarters after arising with the sun and fishing breakfast, dinner and supper out of his front yard.

OUR LITERARY DIGEST

Automatic Telephones, by F. A. Ellson; Sir Isaac Pitman & Sons, London and New York.

This little volume, one of Pitman's Technical Primer Series is intended to be an introductory treatise on automatic telephones. On account of its small compass, no attempt is made to treat all forms of automatic systems but particular attention has been paid to the system of the Automatic Telephone Manufacturing Co. which is the English manufacturer of Strowger apparatus. Special chapters are devoted to the Siemens and Western Electric rotary switch system. Only a brief reference is made to the Western Electric Panel system and the Automatic director system. The book is descriptive in character and stress is laid on the function of the different elements of the systems rather than upon circuit connections. In the appendix is reproduced a list of standard terms used in Great Britain in connection with Automatic telephone systems.

A Handy Combination Telephone Tool

Chicago, Ill.—The Combination Blow Torch Co. has developed what seems to be an exceptionally handy tool—a blow torch that is compact and without the usual clumsy tank. It also can be slipped into a kit or carried on climbing jobs without much effort.

This company also has prepared a lug on the mouth of the barrel which receives various tools, such as soldering tips that have self-contained heat, maintaining proper temperature in all weather conditions and that do not flake and require filing. Also, it has a flame-reducer tip to concentrate the flame at one point; a flexible ladle attachment that always maintains an upright position and on which the flame constantly plays; a rigid ladle attachment that pours from the lower point and consequently eliminates skimming and always pours clean solder; and a branding device to burn trade names or numbers in telephone poles, tools, auto tires, boxes, barrels, etc. This

type or numbers can be changed at will as shown in accompanying cut. These tools and equipment were developed by a demand for such devices and they have stood the test of practical usage. The catalogue this company issues is interesting and enlightening.

Movies Help Illinois Relations Program

Milledgeville, Ill.—Northwestern Illinois telephone executives and traffic heads attended the April district meeting of the Illinois Telephone Association held here on Wednesday, April 15th. The sessions of the executives' conference were held in the Masonic Hall and included a full and complete discussion of telephone rates, pending legislation, and a demonstration of cable splicing by K. R. Lee.

The traffic conference was in charge of Miss Esther Sorensen, Traveling Chief Operator of the Illinois Telephone Association. Computed long distance rate and code cards as issued by the Illinois Telephone Association were distributed, together with the condensed operators' handbook that has been found so useful in the smaller offices of the state.

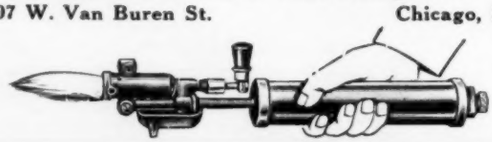
A Powerful Gasoline Torch of Many Uses

With attachments, fitting end of barrel (and maintained at 2100°) for branding, paint scraping, soldering and for reducing solder on cables, etc. Used by largest companies, recommended for time-saving and efficient work under the most adverse conditions, particularly telephone and telegraph work—this equipment is the result of 25 years' specializing.

Send for catalogue.

Combination Blow Torch Mfg. Co.

2807 W. Van Buren St. Chicago, Ill.



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ANY SPECIFICATIONS REQUIRED

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Handy Portable Test Set

Any Practical Telephone Man Can Build This Versatile Set Which Gives Buzzer and Voltmeter Tests—It Is Used for Cord and Direction Finding Line Tests

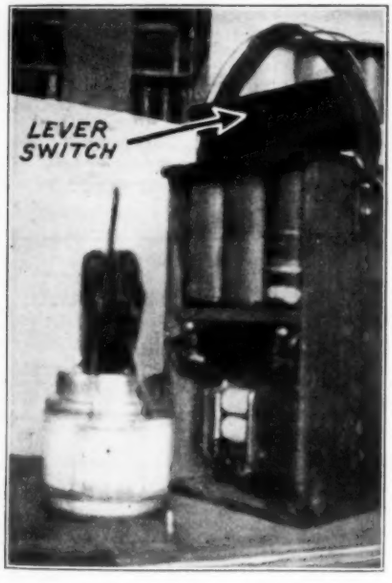
By E. R. COLLINS

In a recent issue of TELEPHONE ENGINEER there appeared an article describing a test set known as a direction finder. The constructional details were not given, so we decided to find out how it worked. The test set I am describing was developed as a result of our experiments.

The following material will be required to build the set. The list given is taken from the set constructed, but any other make of apparatus can be used.

1 No. 1 or No. 2 Lungen buzzer.
1 Stromberg Carlson No. 20 operator's head receiver.
1 Flash light battery, 4 cells, 6 volts.
1 ½ Mf. telephone condenser.
1 .002 radio fixed condenser.
1 75 ohm non-inductive resistance coil.
2 Switchboard jacks.
2 Bulldog No. 3 paper clips.
2 Test clips, Frankel.
1 Jewell or Pignolet peep-hole voltmeter, 5-6 volts, resistance, approximately 350 ohms.
4 No. N. I. E. 3 spring push buttons (Northern Electric).

Miscellaneous screws, hinges, wire and flexible cords.



How the handy test set looks

How the Set Is Built

The wooden case was made in two compartments, with the cover over one end as will be seen in the photo. The one side of the case is fastened on with screws. In this compartment are mounted the coils, batteries, etc. The other compartment is only opened at the top and is to hold the cords, test clips, direction coil and receiver. The cover of the box is hinged in the middle. The half over the battery compartment is fastened solidly. Two brass screws are mounted in the outer surface of the lid, so that when the lid is opened right back the heads of the screws are touching. The screws are wired to the battery and buzzer, and make what is called in the drawing "the cover switch." This makes a control switch that is easy to handle with your mitts on in cold weather, and there is nothing to get broken, and little danger of the batteries running down through accidental contact.

The buzzer is mounted in a soft rubber cushion to deaden the sound.

The operator's receiver is equipped with an elastic band instead of the ordinary head band. A pad is fastened to the elastic to cover the other ear when using the receiver. This shuts out noises, and makes the tone easier to be heard.

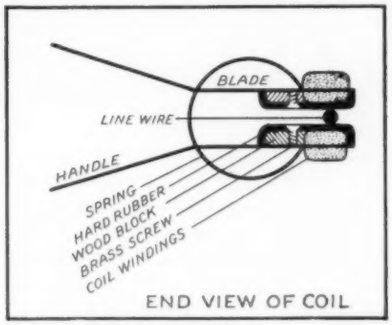
The flash light battery is broken into three sections, and the three sections wired in series by wire soldered to the cells. This is better than relying on the pressure contact of the cells alone.

The telephone condenser is bridged across the buzzer coils as shown in the drawing, and the ½ M. F. proved to be best for the No. 2 Lungen buzzer. A different buzzer might work better with a different condenser capacity.

The .002 radio condenser is used to cut down the volume of the tone when used as a cord test.

The resistance coil is inserted in the tone circuit to prevent the buzzer stopping when testing close to a short circuit.

The telephone jacks should be chosen to fit the plugs on the switchboard, on which the testing is likely to be done. When more than one type of board is encountered, extra jacks wired in multiple will be necessary.



End view of test set coil

The bulldog clips are used to make the direction finder coil. The two long short ones can be reassembled to be used as a paper clip. The blades of the clips are first covered with friction tape. Two short pieces are folded first over the two ends of the blade, and are wrapped over parallel to the handle. Then two more pieces are wrapped around the blade at right angles to the handle, extending over both edges of the blade. The coils are wound on over the blades lengthwise, the coil being at right angles to the handle, and each coil consists of 350 turns of No. 36 S. S. C. wire. The ends of the coil are soldered to flexible leads, and securely fastened. The wrapping of tape is then carefully folded back over the coils and stuck down. The inner faces of the coils are covered with a piece of hard rubber, which can be taken from an old battery jar. Both coils are wound in the same direction. The two coils are then assembled as a paper clip, and the inside ends connected together. The outer ends are connected to a 6-foot receiver cord. The coils can then be given a couple of coats of varnish.

The voltmeter, of whatever type used, should be mounted flush with the cover, and a brass plate arranged to slide over it for protection. The resistance of the voltmeters should be measured with a Wheatstone bridge. If the resistance is an odd figure, say 567 ohms, then it should be adjusted by adding a shunt to make the joint resistance an even figure, say 200 ohms.

The N. I. E. keys are ordinary rural telephone push buttons. They are mounted in the case with the collar just flush with the outer surface. The buttons are ground down, leaving an oval button extending out about ¼ inch. The three buttons are mounted so that they form an arc of a circle, and about ¾ inch apart. A piece of brass rounded at the two edges is mounted so that it will depress one button at a time. This provides a simple key arrangement and one that cannot be broken. The springs of two of these keys are mounted on one frame to form a 6 spring key as shown in the drawing.

The set is then wired according to the circuit drawing. The operation of the set is described under the heading of the different tests to be performed.

Buzzer Test Set—The set can be used as an ordinary buzzer set. With key No. 1 operated, all others normal, a circuit can be traced from test clip No. 1, battery, buzzer contact and coils, make contact of key No. 1 normal contacts of Key No. 2. Normal contacts of Key No. 3 to No. 2 test clip.

Tone Test Set—The tone test is operated by opening the lid of the box, thus closing the contact with the two screws. The tone is set up by the inter action of the buzzer coils, and the ½ M. F. con-

(*Continued on page* 45.)

RECONSTRUCTED EQUIPMENT

Leich Elec. Co., No. 7A Frequency converter furnishes 20 cycle A. C. current for straight line ringing. Operates from 110 Volt 60 cycle lighting Ckt. $40.00

Gray No. 24 Three slot portable pay stations for 5, 10 and 25c coins complete with switch-hook but less Trans. & Rec. or Cords $5.50. With Transmitter, receiver and cords..... 8.25

Stromberg Carlson No. 824 Common battery straight line wood hotel sets complete 5.25

Stromberg No. 357 Straight line Common battery Steel hotel sets..... 5.75

Dean Elec. Co., Straight line Common battery Steel hotel sets $5.25 —Harmonics with 16-33-50 or 66 cycle ringers..... 5.50

Kellogg No. 30 Straight line C. B. Business type wall sets..... 3.75

Kellogg No. 30 C. B. Business wall sets with 16-33-50 or 66 cycle ringers 4.25

Western Elec. Co., No. 1317 3-bar 2500 ohm Bdg. compacts..... 8.00

Western Elec. Co., 2 or 3-bar 1000 or 2500 ohm Bdg. magneto hotel sets.. 6.75

Western Elec. Co., No. 301 E 2 or 3-bar 2500 ohm Bdg. Common battery type magneto wall sets..... 6.00

Western Elec. 2 or 3-bar Bdg. No. 22 type hand generators complete..... 1.50

Western Elec. Co., square base Transmitter arms..... .25

Dean or Garford 3-bar 1000 or 1600 ohm Bd. desk sets $8.75, 4-bar $9.25 5-bar 10.25

Kellogg or Stromberg late type 3-bar 1000 or 1600 ohm Bdg. desk sets $10.00, 4-bar, $11.50, 5-bar..... 12.00

Monarch 3-bar 1000 or 1600 ohm Bdg. desk set, $8.50, 4-bar $8.75, 5-bar.. 10.00

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Ringer Sets, etc.

Some time in June the entire manual equipment of a Stromberg-Carlson Super-Service Switchboard and Toll Board will be released for sale. If interested, we would be glad to hear from you.

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S. & H. Brings Out New "Red Devil" Giant Grip

Irvington, N. J.—Smith & Hemenway Company, Inc., makers of "Red Devil" mechanics' tools, have recently developed a tool that combines a husky plier and a powerful wrench that takes the place of

pliers, pipe, monkey "S" wrenches, etc. It is a self-contained tool kit, because it embraces a multitude of practical tools, say the makers, who add, "The 'Red Devil' Giant Grip handles the most stubborn nuts or bolts just as easily as turning a cotter pin. The leverage applied in a new way gives a non-slip grip to round, square, or hexagon shaped objects, and holds on. The adjustment is changed from a plier to a wrench instantly, and will not slip. The grip is forged from steel and tempered. It is made in 7½ inch size."

Use of the Telephone in Business, by J. C. Scammel. The Ronald Press Company, New York. Ronograph Library—No. 25.

This little book which was not written by a telephone man nor for telephone men, is one which every telephone manager and commercial man should read and they might well see to it that copies are placed in the hands of the men in charge of telephone service in the more important business houses in their localities. The author is a professor in the College of Business Administration of Boston University and he is writing for the business man, the clerk, the salesman and all others who use the telephone in their work. He does not discuss the telephone as a technical device but as an instrumentality for conducting business more expeditiously. Only a few pages over one hundred make up the book and yet the author finds time to discuss the telephone in general, the operation of the private branch exchange, the importance of the voice and the organization of thought and to make application of the principles he has worked out to the use of the telephone in the general conduct of business, in explanations and inquiries, in selling and in making adjustments. The final chapter discusses the application of the telephone in a number of important fields of business.

Altogether, it is a book we can recommend most heartily to those in the business side of the telephone or those who use the telephone in business.

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Western Electric Co. 1020-AL common battery desk sets with steel bell boxes	$10.00
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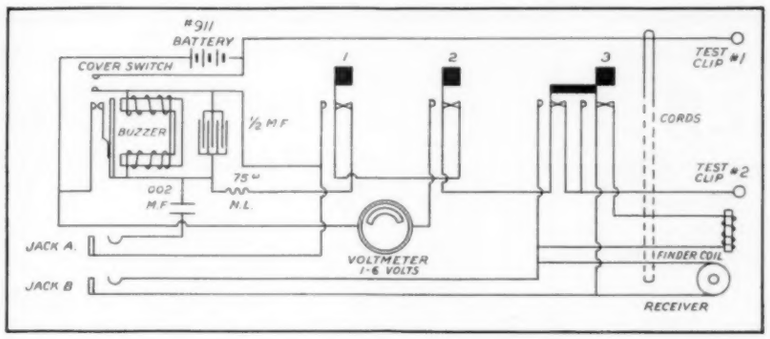
UNIVERSAL DROP WIRE INSULATORS
Universal Specialty Company
120-A, S. 7th St., Terre Haute, Ind.

(*Continued from page* 43.)

denser, with key No. 3 operated, all other keys normal, a circuit can be traced from test clip No. 1, cover switch now closed, buzzer coils and condenser in parallel, 50 ohm non ind. resistance, normal contacts of key No. 1, normal contacts of key No. 2, make contacts of key No. 3, telephone receiver, make contacts of key No. 3, to test clips No. 1.

Direction Finder—When the troubleman is locating trouble, say a cross between two rural lines, key No. 3 is operated. The cover contacts closed, and the head receiver in place. The tone being in series with the receiver the you return to the exchange; the chief operator reports some cords in trouble. Having equipped the test with jacks to suit your switchboard plug, you start the buzzer going with the cover contacts, all other keys being normal. Listen with the head receiver in your set, insert the pair of cords in trouble in the test jacks, and presto, you have your trouble in a jiffy.

The tone for this test is taken through a .002 fixed radio condenser, to cut it down to a place where it is comfortable to work with. The direction coil shunted across the receiver also prevents the tone from being too loud.



Circuit wiring diagram of test set

crossed wires can be determined by the loudness of the tone. When the two wires are located, the test clips are left connected on the line wires, key No. 3 is released. This places the receiver and the direction coil in series. The direction coil is snapped on the line wire in trouble, the line wire being parallel between the two coils. On one side of the test clip no tone will be heard. On the other side the tone will be heard. This is the direction of the trouble.

Voltmeter Test—Now that the direction is known, the next question is how far? Close key No. 2, all other keys being normal, the test clips being still on the line wires. A circuit is now formed from test clips No. 1, battery voltmeters, make contacts of key No. 2, normal contacts of key No. 3, to clip No. 2.

The deflection of the voltmeters is now read. Suppose the reading is 3.

Now touch the test clips together and read the voltmeter again. This reading we will assume is 4.5.

Subtract the first reading from the second, the difference is 1.5.

Multiply 1.5, the difference, by the resistance of the voltmeter, which we will suppose is 200 ohms, $200 \times 1.5 = 300$.

Divide the product 300 by the first reading, which is 3, and you have 100 ohms, the distance to the trouble. For ordinary No. 12 galvanized iron at 66 ohms per mile this would be about 1½ miles to the trouble.

Now that you have found your trouble,

All the apparatus can be mounted in a box 4½x4½x8 inches deep. A carrying strap and a hook should be provided so that the set can be fastened to your body belt, or hooked on a top pin.

It is not an expensive set to build, and will be found to be very valuable.

Southern Indiana Holds Quarterly Meeting

French Lick, Ind.—The Southern Indiana Telephone Association held its quarterly convention at the West Baden Springs Hotel, April 17. On the evening of April 16 the Chamber of Commerce of French Lick and the members of the telephone association met at a joint banquet, B. O. Wells of French Lick, president of the Chamber of Commerce, acting as toast master.

Dr. R. V. Scott of Bedford gave a short talk on Commercial Club activities. Hon. Henry A. Barnhart, president of the Indiana Telephone Association, Rochester, Indiana, also addressed the meeting, giving a portion of his lecture, "Congress in Action."

April 17 Fred Thomas, assistant to the president of the Indiana Bell Telephone Company, delivered an interesting address on "Thrift." Mr. Thomas has delivered the same address to many of the Bell districts and expects to cover the whole state with this story.

R. V. Achatz then took charge of a round table discussion. The question of electrical interference on telephone lines was discussed and remedies suggested; also the proper methods of making study for future extensions on cable plants in towns and cities. This was specially interesting because several of the companies at this time were rebuilding their properties and for this reason the discussions were most effective. D. H. Whitham, General Contract Agent, Indiana Bell Telephone Company, gave a short talk; also J. K. Johnston, telephone engineer. The meeting was well attended and proved to be one of the best meetings held this year by the Southern Indiana Telephone Association.

The next meeting will be held at Milan on July 23 and 24, 1925. Arrangements for the meeting will be in the hands of R. V. Achatz and E. S. Welch. The meeting at Milan will consist of a plant school, operators' school and convention and an invitation is extended to telephone operators throughout the state and also the traveling men to come and spend two days.

Stuart I. Weill Named as W. E. Official

New York City.—Stuart I. Weill has been appointed Assistant to Vice-President of the Western Electric Company. This appointment follows the recent resignation of J. L. Kilpatrick as Vice-President in charge of the Telephone Department of the company, and it is to this department that Mr. Weill has been assigned.

Mr. Weill studied electrical engineering at the University of California and entered the employ of the Pacific Telephone and Telegraph Company in 1909 to engage in engineering work at San Francisco. He went subsequently to Portland where he occupied a number of important posts related to construction and plant. In 1917 he was back in San Francisco on the staff of the General Superintendent of Plant, and was then transferred to the American Telephone and Telegraph Company as accountant in New York.

On his return from overseas service he rejoined the American Telephone and Telegraph Company, but in 1923 he left to become General Accounting Superintendent of the Installation Department of the Western Electric Company.

Russian Telephone Lines Increase 50% in Two Years

Washington, D. C.—Telephone line mileage in Russia increased over 50 per cent in the last two years, according to a report of the Commissariat of Posts and Telegraphs received by the Russian Information Bureau in Washington. At the close of the year there were 25,028 kilometers of telephone lines in the Soviet Union.

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